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Ann of Rann } 6182b
of Blackwater }

Great Britain. Commission for Wm Hancock

Drainage and Navigation, under the Act 5 & 6 Vict., chap. 89.

LOUGH NEAGH DISTRICT.

REPORT TO THE COMMISSIONERS

APPOINTED UNDER THE PROVISIONS OF THE ABOVE ACT,

ON THE

DRAINAGE OF THE FLOODED LANDS

AND THE

IMPROVEMENT OF THE NAVIGATIONS

IN THE

ABOVE DISTRICT,

BY

JOHN MACMAHON,

VICE-PRESIDENT OF THE INSTITUTE OF CIVIL ENGINEERS OF IRELAND.

TOGETHER WITH A REPORT ON THE VALUATION

OF THE

FLOODED AND INJURED LANDS IN THE DISTRICT.

BY

R. HARDING.

DUBLIN:
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1846.

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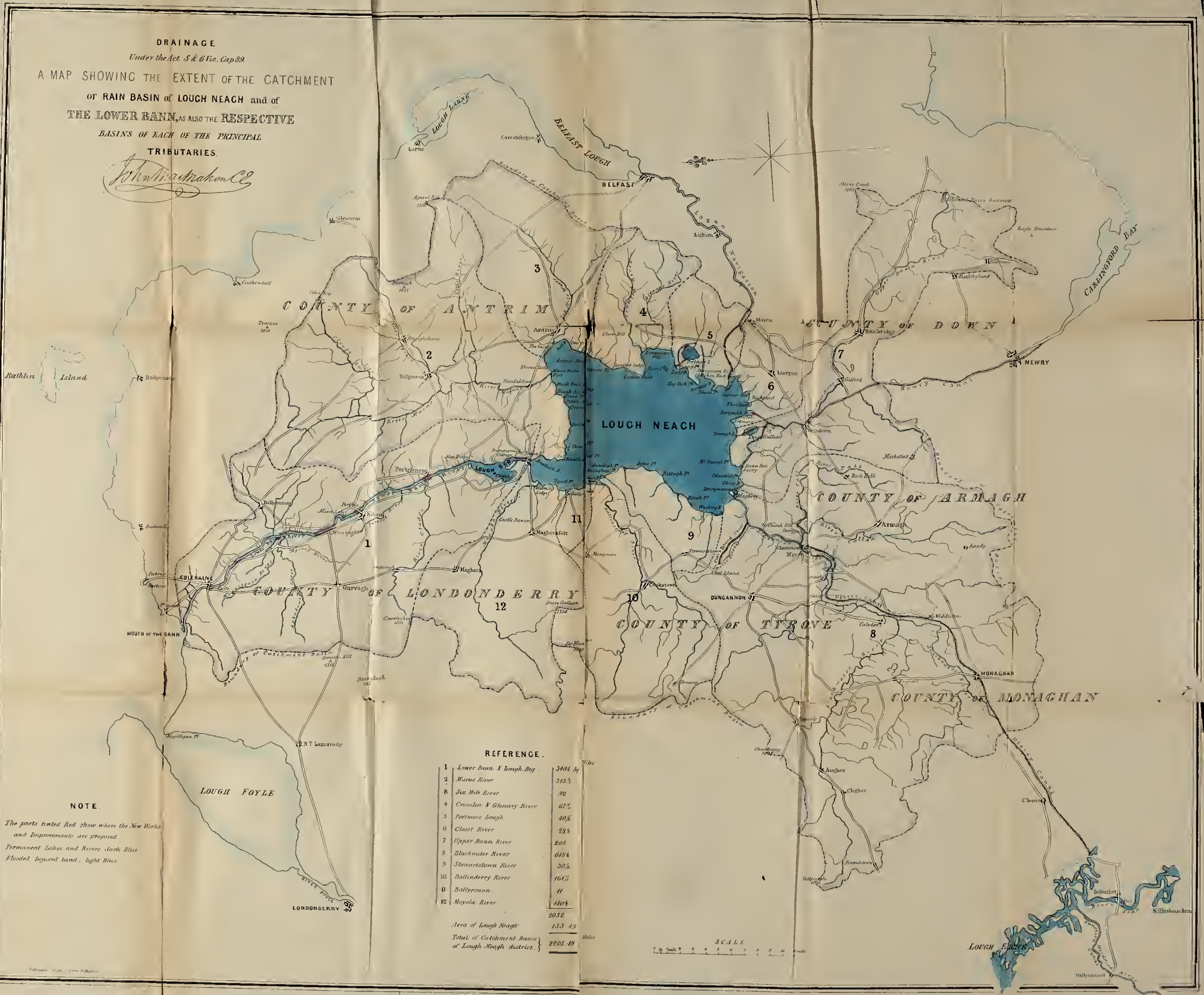
DRAINAGE

Under the Act 5 & 6 Vic. Cap 89.

A MAP SHOWING THE EXTENT OF THE CATCHMENT or RAIN BASIN of LOUCH NEACH and of THE LOWER BANN, AS ALSO THE RESPECTIVE *BASINS OF EACH OF THE PRINCIPAL* TRIBUTARIES.

John Macmahon C.E.



REFERENCE.

1	*Lower Bann & Lough Beg.*	340¼ Sq Miles
2	*Maine River*	313½
3	*Six Mile River*	92
4	*Crumlin & Glenavy River*	67¾
5	*Portmore Lough*	40½
6	*Closet River*	28½
7	*Upper Bann River*	208
8	*Blackwater River*	618¼
9	*Stewartstown River*	30½
10	*Ballinderry River*	161¼
11	*Ballyronan.*	11
12	*Moyola River*	140½
		2052
	Area of Lough Neagh	153 49
	Total of Catchment Basin of Lough Neagh district.	2205.49 Miles

NOTE.

The parts tinted Red show where the New Works and Improvements are proposed

Permanent Lakes and Rivers dark Blue

Flooded Injured land, light Blue

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Drainage and Navigation, under the Act 5 *&* 6 *Vict., chap.* 89.

REPORT

ON THE

LOUGH NEAGH DISTRICT.

For the purpose of simplifying the consideration of this subject, I propose, in the following paper, to divide it into six separate heads.

I.

The present circumstances of the Lower Bann, Lough Neagh, and its Tributaries, both as to the natural and artificial impediments by which the free discharge of their waters is prevented, internal navigation hindered, and the adjoining lands subjected to injurious flooding.

II.

The present General Means of Transit, with a statement descriptive of the extent to which these waters and the artificial canals connected with them, in their present state, conduce to the commercial prosperity of the contiguous district, by the facilities which they afford for the transit of home and foreign produce.

III.

The Sanitary Effects of Land Drainage, with evidence as to the injurious effects which the marshes, formed by the annual retiring of the pent up floods, or rather the exhalations from those marshes, have on the sanitary condition of the surrounding population.

IV.

THE PROPOSED MEASURES OF IMPROVEMENT which, after mature consideration, appear to me to be the most effective for relieving from injury the lands on the shores of the Lough, and on the banks of the rivers connected with it, which are at present subject to be flooded by the frequent overflowing of their waters. Also certain modifications in the discharging channel, the "Lower Bann," calculated to convert that river into a valuable navigation from the lake to the sea, suited to the passage of cross-channel craft, and screw-propelled steam tugs.

V.

THE ESTIMATED COST of the measures for Drainage and Navigation.

VI.

THE BENEFITS ANTICIPATED TO RESULT from the proposed measures.

FIRST.

PRESENT CIRCUMSTANCES OF THE LOWER BANN, LOUGH NEAGH, AND ITS TRIBUTARIES.

The noble lake which forms the most prominent feature in this inquiry, and which has for so many years been an object of much interest, as well to literary and scientific men as to practical engineers, holds a central position in the most populous and prosperous province of our island, abutting on five important counties.

It has Antrim on the north, Antrim and Down on the east, Armagh on the south, and Tyrone and Londonderry on the west; thus encompassed, its waters spread over an area of 98,235 statute acres,* its surface standing, on the 21st of June, 1844, about 48 feet above the low water of spring tides at Coleraine, having in a very limited portion of its great expanse a depth of water amounting to 100 feet, and an extent of surface, as above stated, which considerably exceeds any other fresh water lake in the United Kingdom.

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* Exclusive of Lough Beg, which contains 3,144 acres, making a total of 101,379 acres.

There is probably no circumstance which more forcibly arrests the attention of one who studies the physical features of this portion of the north-east of Ireland, with a view to its improvement by drainage, than the immense expanse of surface covered by the waters of this Lough. He sees a lake extending from north to south more than 17 miles, and from east to west, on an average, 10 miles; and the interest thus excited, is by no means diminished when, on examining the Chart of this "Inland Sea," and the diagram map of the district in which its rain water or catchment basin is situated, he finds many large rivers, and innumerable streams and rivulets employed in discharging the surplus waters of upwards of 1,865 square miles of country into this great reservoir; and further ascertains, that it has but one visible discharging channel, the Lower Bann River, (which has an additional rain basin, peculiar to its own course, of 340½ square miles,) allotted by nature to convey the entire of these accumulated waters to the sea.

To describe here each of these rivers separately, would not be of any practical use; the Lower Bann, and some of the tributaries, however, stand prominently forward, and demand particular attention, on account of the large extent of country which is dependent on them for drainage, and the injury which is occasioned to the low-lying lands on their banks, by their inadequacy to discharge the waters of the autumnal and winter floods.

LOWER BANN.

The Lower Bann River, the only visible discharging channel for the surplus waters of Lough Neagh, follows throughout the entire of its course a natural depression in the trap rock, which forms the prevailing surface rock of this district.

This river is interrupted in two places by ridges of rock crossing its stream, and producing those rapids or falls that break its course. The first of these, going up stream from the town of Coleraine, (the northern extremity of the Lough Neagh drainage and navigation district,) is that at the Salmon Leap or Cuts, about 1½ miles above the town, and 7 miles from the sea. The barrier here, a dyke of basalt, extends quite across the river, and upwards from the Cuts about 500 yards; the inclination of its surface in this direction is gentle, but below it is quite precipitous, descending into a deep pool; the ascent from the high water of ordinary spring tides, which reaches to the foot of this barrier, to the level of low summer water, immediately above it, is from 4 to 4½ feet, and the extreme width of the river here does not exceed 350 feet. On the western or Derry side there are the ruins of a large flour mill and kilns, (the property of the *Irish* Society,) the destruction of which was caused by accidental fire some years ago, and no attempt (from causes which I did not learn,) has since been made to restore them. The valuable Salmon Fishery at this station is also the property of this Society, farmed at present by the representatives of Messrs. Little.

The cribs in which the fish are taken, occupy a large portion of the breadth of the river, the space unobstructed not exceeding 60 feet. The walls of these cribs, and the site of the manager's lodge, also unnecessarily interferes with the present limited waterway, which, including the opes of the 5 cribs now in use, is reduced to about 230 feet; and even this is further interfered with, and the free flow of the water retarded by the gratings with which these cribs are necessarily enclosed.

From the termination of the shoal at the "Cuts" upwards to the Loughans, the depth of water averages

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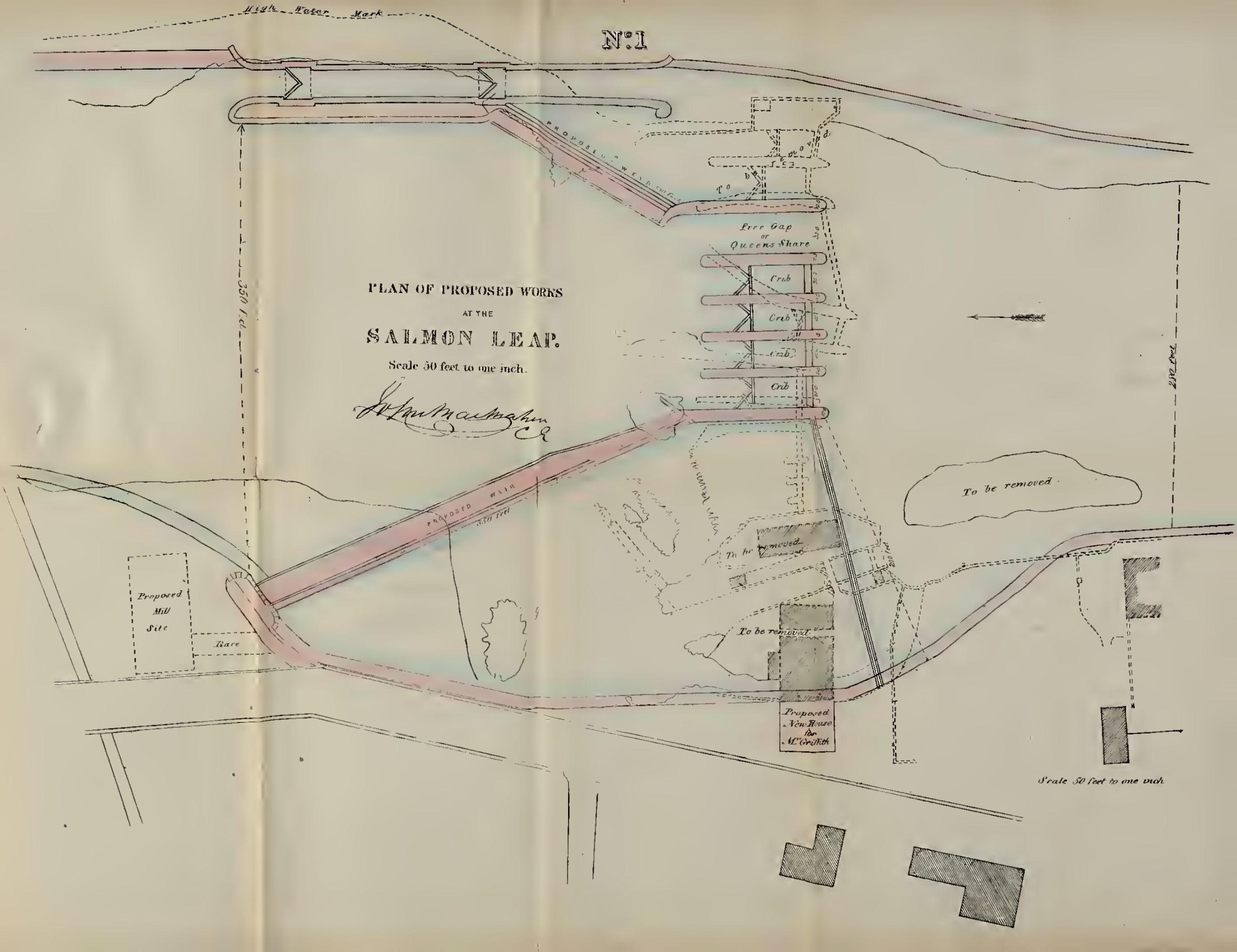

No. 1

PLAN OF PROPOSED WORKS
AT THE
SALMON LEAP.

Scale 50 feet to one inch.

MacMahon C.E.

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12 feet, the least being 9 feet; at the mill, Loughan's Townland, it shoals to 4 feet, and at Loughan's Island, where the stream is divided, the depth is reduced to 3 feet, the ascent at this place being about 9 inches at low summer water. There is at all times a strong current through the channels, the banks are, however, high, and little injured by floods.

From the Loughan Island to Gill's Ferry, the depth of the water varies from 6 to 14 feet; the bottom is of gravel, and the banks high. Ascending from Gill's Ferry the valley gradually opens out; on the eastern or Antrim side the Glenstall River and mill stream enters, and on the western side, a short distance higher up, the Macosquin River forms a junction with the Bann.

At Agivey, 6 miles from the "Cuts," the river is crossed by a timber bridge,* with stone abutments and land wings sustaining the approaches. It consists of 6 opes or arches, formed by 5 rows of piles driven into the bed of the river. The entire width from abutment to abutment is 200 feet, the roadway 23½ feet, and its height above summer water 7½ feet.

A short distance above the bridge, on the west side, the Agivey River enters; it is of considerable magnitude, and a powerful tributary in time of floods. About half a mile up from the Bann it is joined by the Aghadowey River from the northward, and the two united, discharge the drainage of a large district into the Bann.

For several miles above and below the bridge, the meadow lands on each side of the river are low and subject to much injury from floods, being frequently covered with from 2 to 3 feet in depth of water, during the winter months.

About a mile above Agivey Bridge the Rooghan Shoal is situated; it is about a quarter of a mile in length, and the present depth of water on it in summer, averages 4 feet 6 inches, and on the Drumeil Shoal, standing a mile higher up, there is nearly the same depth of water;—this last shoal is not more than 120 yards in length, the valley here closes in and the banks are high. At about 9 miles from the Cuts, the Carnroe Shoal commences; its length is close upon 2,000 yards, and the ascent at it 3½ feet, the depth of the stream averaging from 2½ to 3 feet. Near the middle of this Shoal, the encroachment of the river on the east bank, has been such as to form a small island by the eroded earth.

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* This bridge was built under the direction of William Bald, C.E.

After we pass the pool at the Vow Ferry, where the water is 13 feet deep, there is a shoal about a quarter of a mile long, with a depth of but 4 feet of water in summer.

The next shoal met with in going up the river is that called the Movanagher Rapids; the total ascent here is 10½ feet in low summer water. The depth of the stream, in the bed of the river, varies from 2 to 3 feet. The greater part of this shoal or obstruction is composed of gravel and boulder stones, but at the upper end it is rock.

On these rapids several eel weirs have been constructed, which impede the discharge of the stream, and in many instances direct its force prejudicially, so as to cause a considerable degradation of the banks, and consequent waste of land.

In ascending the rapids, the stream winds towards the east; but at their upper end it turns rather sharply to the southward, and above Moor Lodge again takes a westward direction. The Gortaclooney River enters here, on the east side, where the meadow land is low and subject to floods. Upstream of this there are two small shoals, before Kilrea Bridge is arrived at, the water on these is from 6 to 7 feet deep.

The shoal on which Kilrea Bridge stands, is a quarter of a mile long, and the depth of present summer water but 4 feet. The bridge consists of 7 semicircular arches of 28 feet span each, with piers 7 feet in thickness. The piers and arch quoins are of ashlar stone, and all the rest rubble masonry; it is in tolerably good repair.

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yards in length, the valley here closes in and the banks are high. At about 9 miles from the Cuts, the Carnroe Shoal commences; its length is close upon 2,000 yards, and the ascent at it 3½ feet, the depth of the stream averaging from 2½ to 3 feet. Near the middle of this Shoal, the encroachment of the river on the east bank, has been such as to form a small island by the eroded earth.

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No. 2.

PLAN OF PROPOSED WORKS
AT
CARNROE.

Scale 440 feet one inch.

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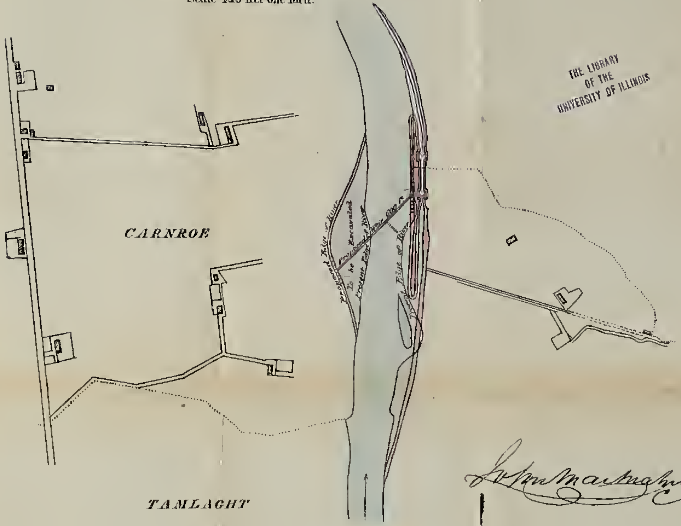

John MacMahon C.E.

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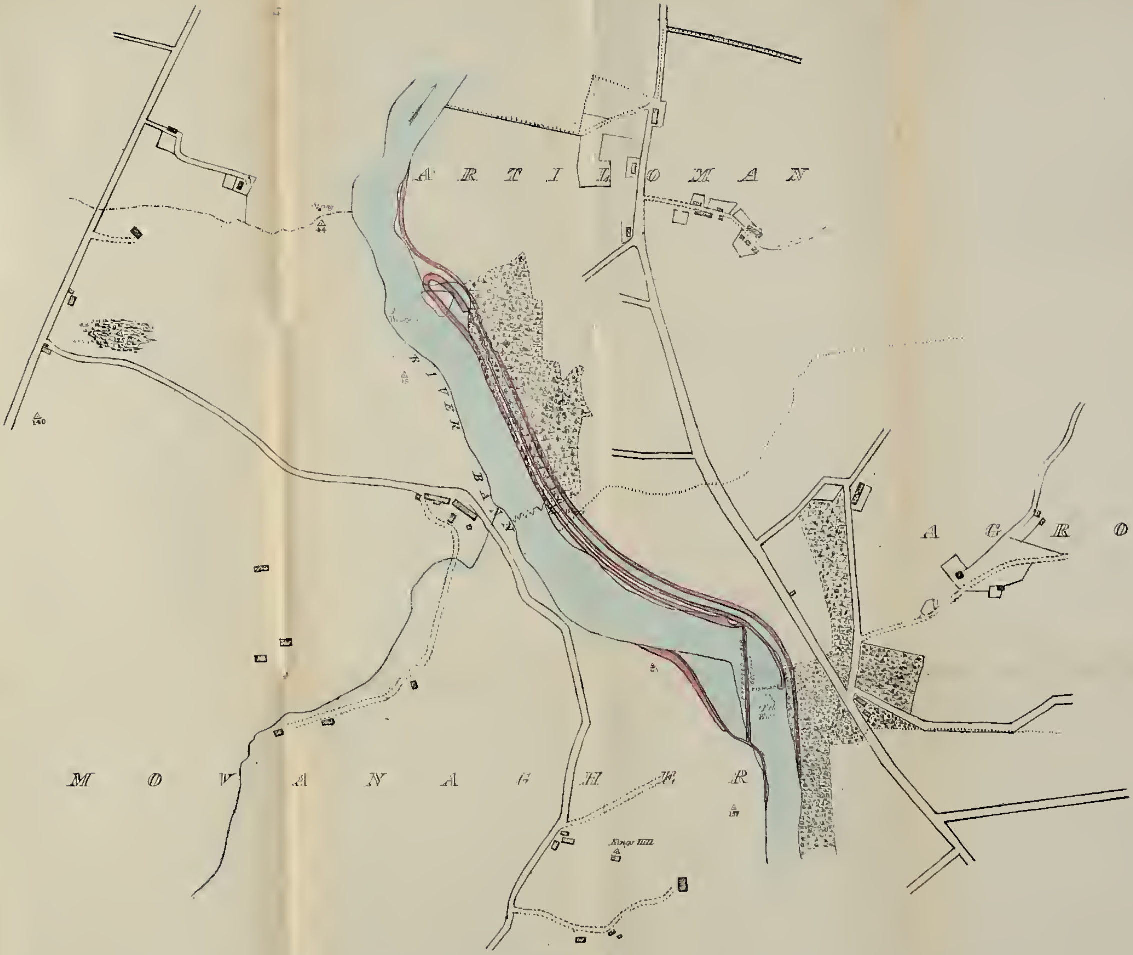

PLAN OF PROPOSED WORKS

AT

MOVANAGHER.

Scale 440 feet to an inch,

John Macneill C.E.

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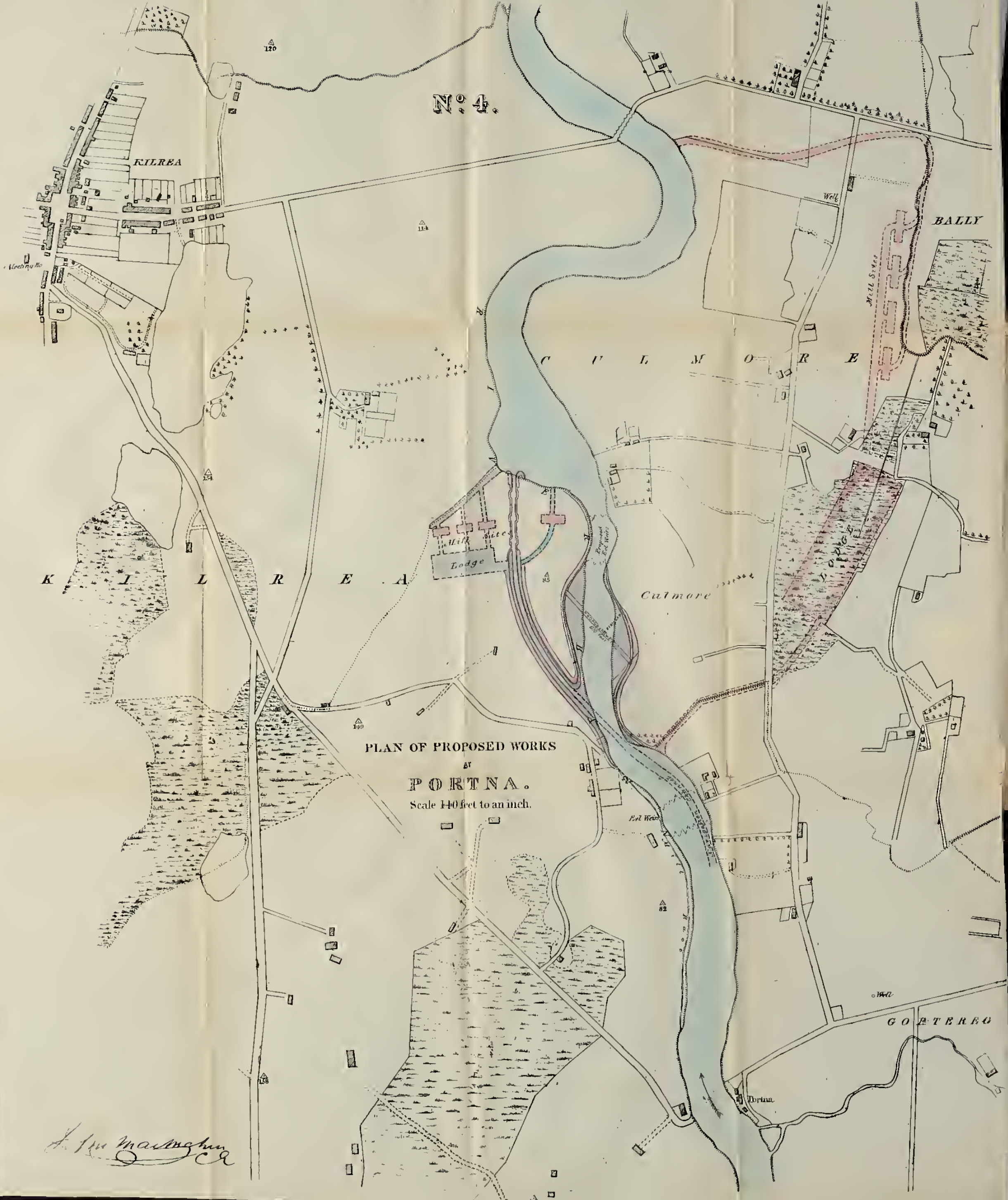

PLAN OF PROPOSED WORKS
AT
PORTNA.
Scale 140 feet to an inch.

MacMahon C.E.

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Above the bridge the river-course winds very much, and is of great depth up to the foot of the Portna Rapids.

These rapids are altogether about a mile in length; but the portion of the river here, usually called the Falls of Portna, is only about half that length; the total ascent, during low summer water, is 18 feet. The aclivity being divided into numerous irregular tables or steps, in which the trap rock predominates, the stream runs with great velocity and force, and the tortuous channels in which it flows in greatest depth, are so intricate, that it is a work of some danger and much difficulty to guide even a fishing boat through them.

The obstruction at Portna is that which impounds the surplus waters of the great catchment basin of this district, containing an area of 1,865 square miles, or 1,193,600 statute acres; it is also the limit to which traffic can, at present, extend by water from Lough Neagh, or the navigations connected with it. No trade boat can venture down these falls, and it is totally impracticable for them to pass upwards. On the crest of the fall are placed two series of eel weirs, embracing nearly the entire width of the river.

These weirs tend greatly to obstruct the free discharge of the surplus waters, and, consequently, to increase the flooding of the lands lying between Portna and Lough Neagh. The manner in which they are constructed affords resting places for the gravel and stones brought down by the strength of the current in floods, thus raising the bed of the channel and otherwise diminishing its capacity. And if to these natural results, are superadded the influence of the great masses of material which compose these weirs, and which, in their repairs for fishing purposes, are periodically increased, we at once discover a cause that, without any extraneous assistance, possesses quite power enough, *in time*, to produce all the evils with which this district is visited.

The rock extends upwards from the weirs, nearly half a mile, dipping rather suddenly towards the east or Antrim side of the river, where it is overlaid by gravel, clay, and boulder stones.

From Portna to the lower end of the shoal at Portglenone, a distance of about 5 miles, the depth of water averages 20 feet, the least depth being 16 feet.

The lower shoal of Portglenone, about 700 yards north of the bridge, is composed of hard gravel and stones; the depth of water on it may be taken at an average of 4½ feet in the centre of the river; but near the east bank there is a narrow channel 10 feet deep.

Above this shoal, the river is crooked, and a large bay has been formed on its eastern side; the water here is 14 feet in depth, but it soon shoals as it approaches the bridge, where it is only about 4 feet deep.

The bridge consists of 7 arches of the same size, or very nearly so, as those of Kilrea Bridge; the aggregate waterway between the piers and abutments, is 193 feet 9 inches, but it is much obstructed by the sterlings, and the rubble stones put in to defend the foundations, which occupy more than 30 feet of the space below the summer level. The entire structure is in a very ruinous condition; the piers have been founded on or near the compressible bed of the channel, and from unskilfulness in construction have yielded to an alarming extent, as the numerous settlements and fissures in this dislocated structure attest. The materials and workmanship are of the most inferior description, and no warranty, short of reconstruction, can be offered for its security. It appears that a portion of the bridge fell in the year 1798, but was soon after restored, the ruins, however, were left in the river, and add considerably to the inconvenience caused by former obstructions.

The public officers in charge of the repairs of this bridge, the expense of which is borne by two counties, had to resort to wrought-iron ties to try and bind it together, but destruction has got it so firmly grasped, that no mechanical expedient will long procrastinate its doom.

A very short way above the bridge, the water deepens to 12 feet; but at about 300 yards higher up the stream, there is a large shoal composed of gravel, clay, and stones, on the crown of which the water does not exceed 3 feet in depth; the breadth of the river here is, however, very great, and so far its shallowness does not much retard the passage of the flood water.

In ascending from Portglenone to New Ferry, going towards the Lough, the water becomes deep, ranging from 17 to 45 feet for about 3½ miles, and the breadth of the river averaging from 200 to 300 feet. At the New Ferry the depth of water is reduced to 13 feet, closing in on the western bank, and to about 10 feet towards the eastern bank; above the Ferry its depth is upwards of 20 feet, at which it continues to the bar or shoal at the down-stream entrance into Lough Beg.

Lough Beg extends for 3½ miles in length, in the direction of the sailing course, and its greatest breadth is about 1 mile; its shores are in general low, especially the western, which is composed of clay, sand, and bog; the eastern shore is rocky, and has numerous creeks, and small bays, formed by lengthy projections of trap rock, and by numerous islets.

At the lower entrance adverted to, there is an extensive shoal of mud, sand, and boulder stones, crossing the direct sailing course out of the lake, and on which there is very little water in summer; near its northern shore, however, there is a channel with rather more than 6 feet of water, and although crooked is generally used by the boatmen who navigate the Lough. The shoal consists of a soft material to a great depth.

The surface of the shoal, or bar, at the southern end of Lough Beg, is dry during low summer water.

The new cut, as it is called, commences here; it runs deep, (that is from 12 to 17 feet,) and from 120 to 130 feet in width. The banks stand nearly perpendicular, and in consequence are subject to frequent slips, from being under cut by the action of the current.

The water becomes shallow in the centre of the river, approaching the eel weirs at Brecart; where the diluvial clay, and boulders of the adjoining upland protrude into the stream to nearly half its width, the depth of water is only from 3 to 6 feet; however, on the west side, there is a deep channel the whole of the way. A short distance above the eel weirs, the river turns quickly to the westward, thus making the sailing course very tortuous; but as the channel is wide, and 18 feet in depth, this inconvenience is not much felt. The west bank along here is high, while that on the east is low and broken, and under the influence of the floods during a great part of the winter season. Near Toome Bridge, there is a great accumulation of sand, which forms the patch called Goose Island; its junction with the western bank is barred in summer, leaving but a narrow passage for the flood waters. On the east side the channel is 13 feet deep, but not of great width.

Toome Bridge has 9 arches of unequal dimensions, varying from 20 to 41 feet in span. The masonry of the abutments and piers was commenced at the level of low summer water; the abutments and five of the piers *rest upon masses of rubble stone*, thrown promiscuously into a space enclosed by a single row of piles bound together by wale pieces and ties; the remaining three piers in the deep part of the river *rest upon piles* cut off at the level of summer water, and bound together by capsills and wale pieces; and in all cases their substructures are defended by large masses of rubble stones thrown around them, by which the water-way below summer level, is reduced at least one half, thus affording in itself a sufficient cause for much of the evil that exists.

This bridge was built by one of Lord O'Neil's ancestors, in the year 1785. Previous to its erection, travellers crossed the river in a frail boat: the ferry is said to have been established at a very remote period. The foundation of the bridge stands on a ridge of hard dilu-

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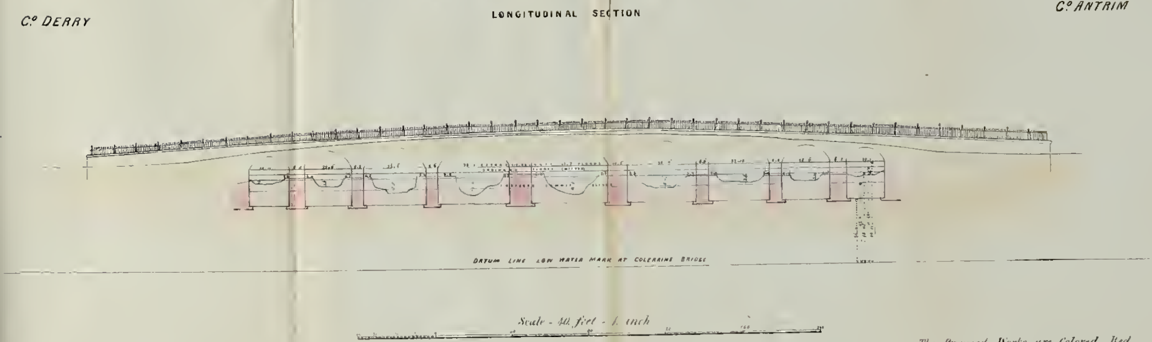
TOOME BRIDGE.

LONGITUDINAL SECTION



The Proposed Works are Colored Red

H. Gonne Lith 11 Miller St. Dublin

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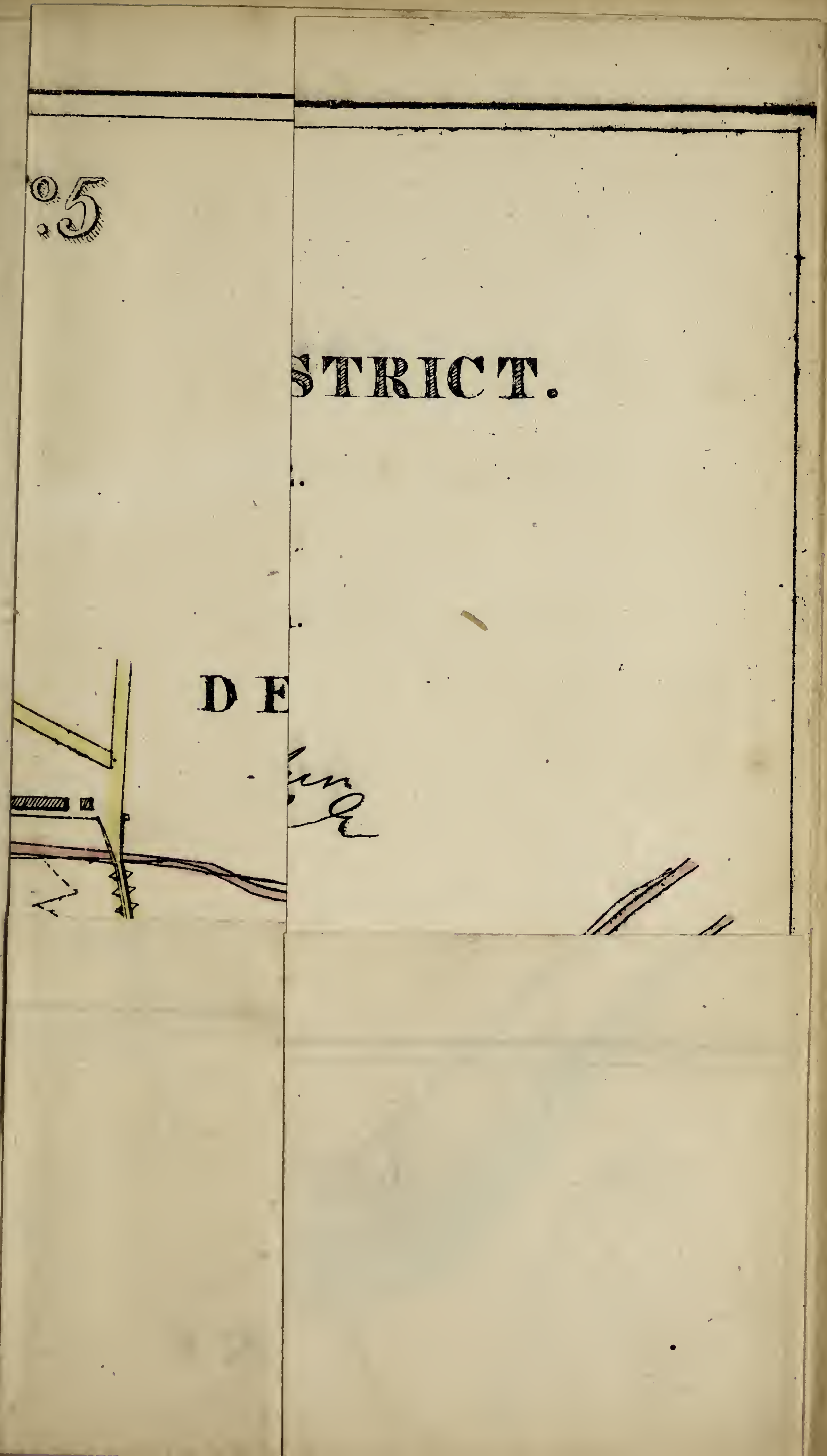
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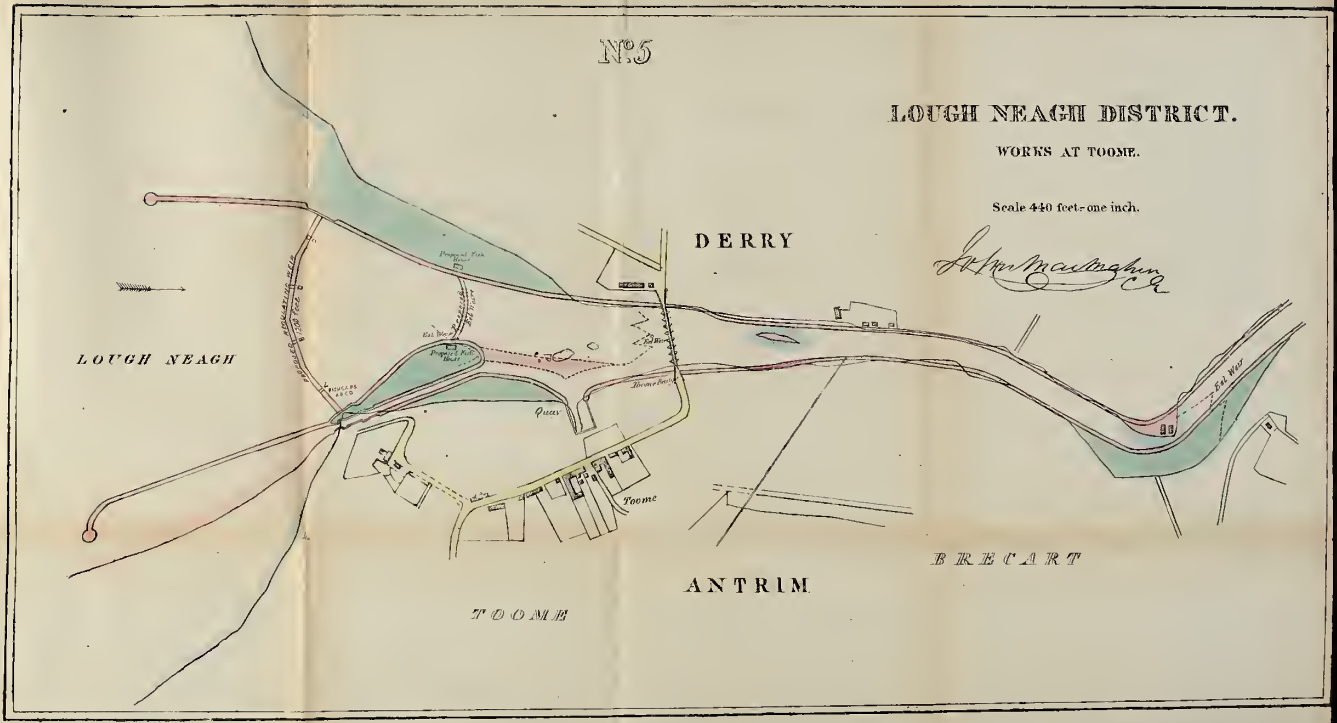

N°5

LOUGH NEAGH DISTRICT.

WORKS AT TOOME.

Scale 440 feet = one inch.

John MacMahon C.E.

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vial clay (of a bluish colour), mixed with gravel and stones.

The subsidence of one of the piers, after its erection, created great alarm for the safety of the whole structure; it was in consequence, deemed necessary to add to its dimensions, notwithstanding it has gone down since the completion of the arches, as is evident from the rents now visible in the spandrels. Apprehensions being generally entertained of the stability of the artificial foundations, as a precautionary measure, the approaches were never raised to their intended height; they are, therefore, left inconveniently steep. With a view of further lightening the superstructure, a cast-iron railing was substituted for the usual parapets of stone.

The bridge is private property, and a heavy toll is levied by Act of Parliament for its use; it has, notwithstanding, been of great advantage to the public, being the principal means of communication between the counties of Derry and Donegal, and the southern part of Antrim, as well as the extensive market and port of Belfast.*

Between the bridge and Lough Neagh there are two eel weirs; the first having three eyes or gates, and embracing the whole of the river, except a small part on the east side, left for the purpose of navigation; the second or upper weir, has only one eye or gate, and occupies about one-half of the breadth of the stream. These weirs are very substantial structures, consisting of a double line of piles, from 5 to 8 inches in diameter, driven into the bed of the river, and bound together by horizontal pieces, treenailed on to them; between these, two rows of piles, the "Skeas," strong wattle or hurdle work are placed; and to enable the weir thus constructed to resist the force of the current, which, from the closeness of the work lies heavily against it, it is supported by numerous sloping strut piles, firmly driven, and well secured. The effect of those obstructions on the water-way of the river has been highly prejudicial; the shelter they afford induces the deposit of sand to such an extent, that the greater part of the channel has only a few inches of water on it in summer; and numerous islands have been raised to such height, as to be dry for several months in the course of the year. The direction of the deep part of the channels, which are narrow and tortuous, is governed by the eyes of the several weirs, and to augment the evil, other serious obstructions, also artificially formed by piles and stones, are to be met with here, on which watch-houses are erected for the accommodation of those who farm the valuable eel fisheries at Toome.

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* Under the provisions of the Act 6 & 7 William IV., c. 116, s. 120 and 121, powers are given to counties to purchase such bridges, and thus make them free of toll. There can be no doubt of the benefit that would result to the counties from doing so in this case.

The bar at the entrance into Lough Neagh is of great extent, reaching nearly a statute mile into the Lough; the entrance is 1,700 feet in width, and the depth of the water on it in summer is on an average about 18 inches, except the narrow channel near the eastern side, which was deepened about 25 years ago for navigation purposes, and the increased force of the stream through it has since preserved it in some measure from being silted up. The greatest accumulation of sand is on the western shore of the Lough, principally, if not altogether, caused by the debris of the River Mayola which discharges into Lough Neagh, about a mile and a half to the west of the bar. This river flows through a mountainous country; is very rapid in its descent, and brings down a great quantity of detritus, principally sand, which is formed into extensive shoal banks at its debouche.

The natural flow of the water to the Bann at Toome, which is the only exit from the Lough, added to the violence of the waves during westerly winds, carries the sand of the Mayola and of the Lough towards the river, and there meeting with the obstructions just described, the great sand bank, generally known as the Bar of Toome, has been formed, and continues gradually to increase, to the great prejudice of an extensive and valuable district of country.

It may be proper here to state, that in addition to the water-way at Toome Bridge, there are numerous auxiliary vents constructed to assist in the discharge of the surplus water in times of extraordinary floods; these consist of several small apertures, of various sizes, principally arched, with which the causeways, leading from Toome to Magherafelt, Castledawson, and Kilrea, are perforated.

At the eastern or Toome end of the large bridge there are four low openings, 38 feet aggregate span, and on the old road, Newbridge and Castledawson road. On the west end of Toome bridge there are 7 arched apertures of the following dimensions, viz.:—

1st—1 arch, 10 feet span.
2nd—4 arches, 10 feet each, 40 feet.
3rd—1 arch, 10 feet span.
4th—2 arches, 5 feet 9 inches each, 11½ feet.
5th—2 arches, 10 feet each, 20 feet.
6th—4 arches, } 3 arches, 12 feet each, and one of 10 feet, 46 feet.
7th—1 arch, 10 feet span.

These have, together, a water-way of 185½ feet, available in aid of the passage through Toome Bridge in the discharge of *extraordinary floods;* the level of the ground or water passage, however, under these bridges, varies from a few inches to 3½ feet over summer water, whilst the land between them and the river and Lough, stands above the level of ordinary floods, consequently their assistance in the discharge of the surplus waters of the Lough is not available, until the flood waters have risen above their ordinary height. The lowest part of the road under which these vents are constructed is 6·54 above the summer level of the Lough. There is no account of the water at any time having passed *over* this road, the greatest height of extraordinary floods must therefore be under its level, even with the additional elevation given to such floods by a strong south-west wind forcing them against the shore. There is on record one instance of the *road* being broken through by the violence of storm, and all transit stopped, but *on no occasion have* the floods, by any extraordinary elevation of the waters, overtopped it.

MAYOLA RIVER.

The Mayola River, rising in the beautiful and fertile valley of Ballynascreen, (County of Londonderry) and which has a catchment basin of 140 square miles, receives a large amount of the drainage waters of the north side of the Slieve Gallion mountain range; and forming the exit for the whole of the waters of the district, in which the towns of Maghera, Draperstown, Tobermore, and Castledawson are situate, after a lengthened and obstructed course, discharges into the lake near Toome Bridge.

It is subject to sudden floods, which rise to a great height, and frequently do considerable damage, notwithstanding the banks are generally so much elevated above its bed. In times of flood it carries down large quanties of *sand and gravel*, which form extensive shoals, annually advancing into the Lough, and stretching along the shore to Toome Bar.

The new bridge (as it is called) which crosses this river near the lake, is founded on a timber platform, which stands higher than the general level of the bed of the channel; and the position of the structure in other respects being most injudicious, it offers great resistance to the floods. There are also several sharp turns in the water-way of the channel above the bridge, tending greatly to retard the free flow of the water, and thereby assist in causing the upper lands to be flooded.

BALLINDERRY RIVER.

The Ballinderry River receives the entire waters of

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No 6

DIAGRAM SECTION
OF
LOWER BANN.

Scale of Heights 5 ft to an inch

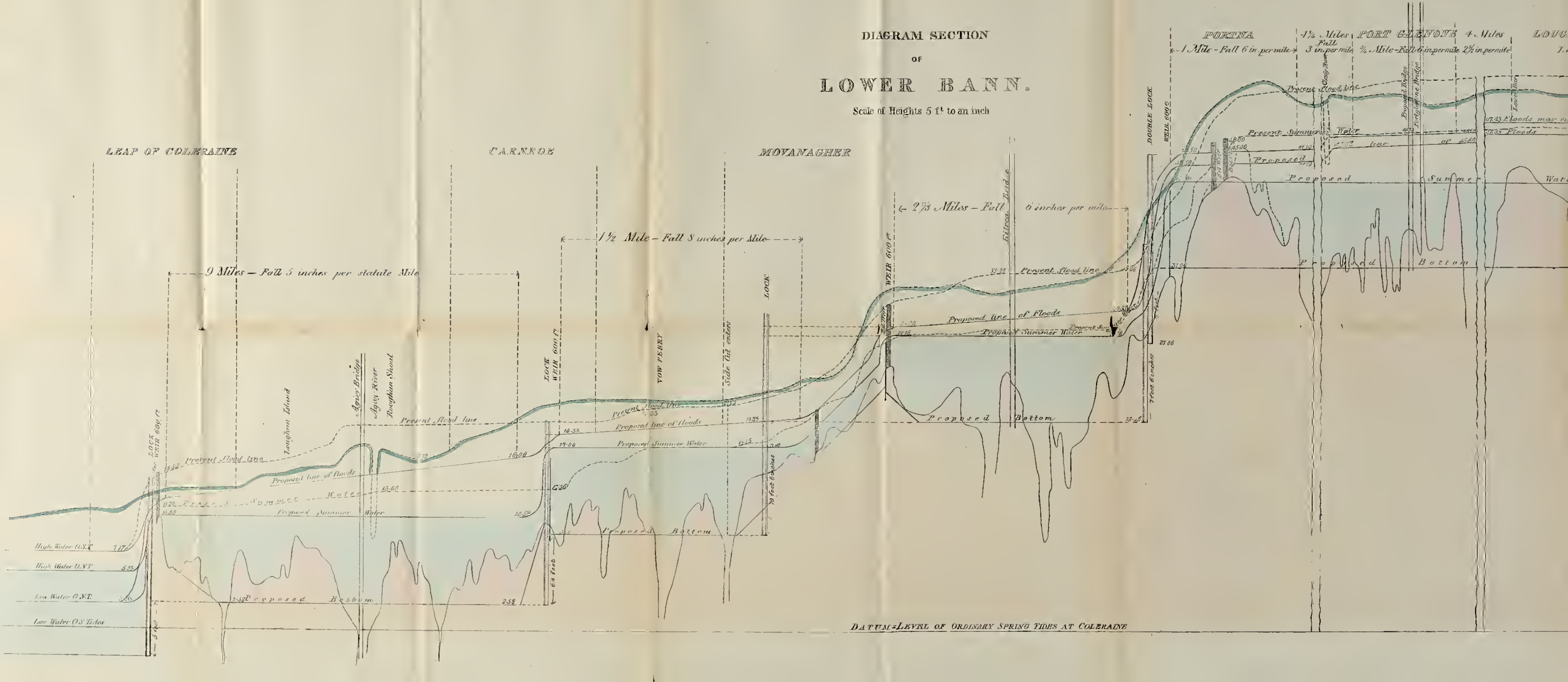

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DIAGRAM SECTION
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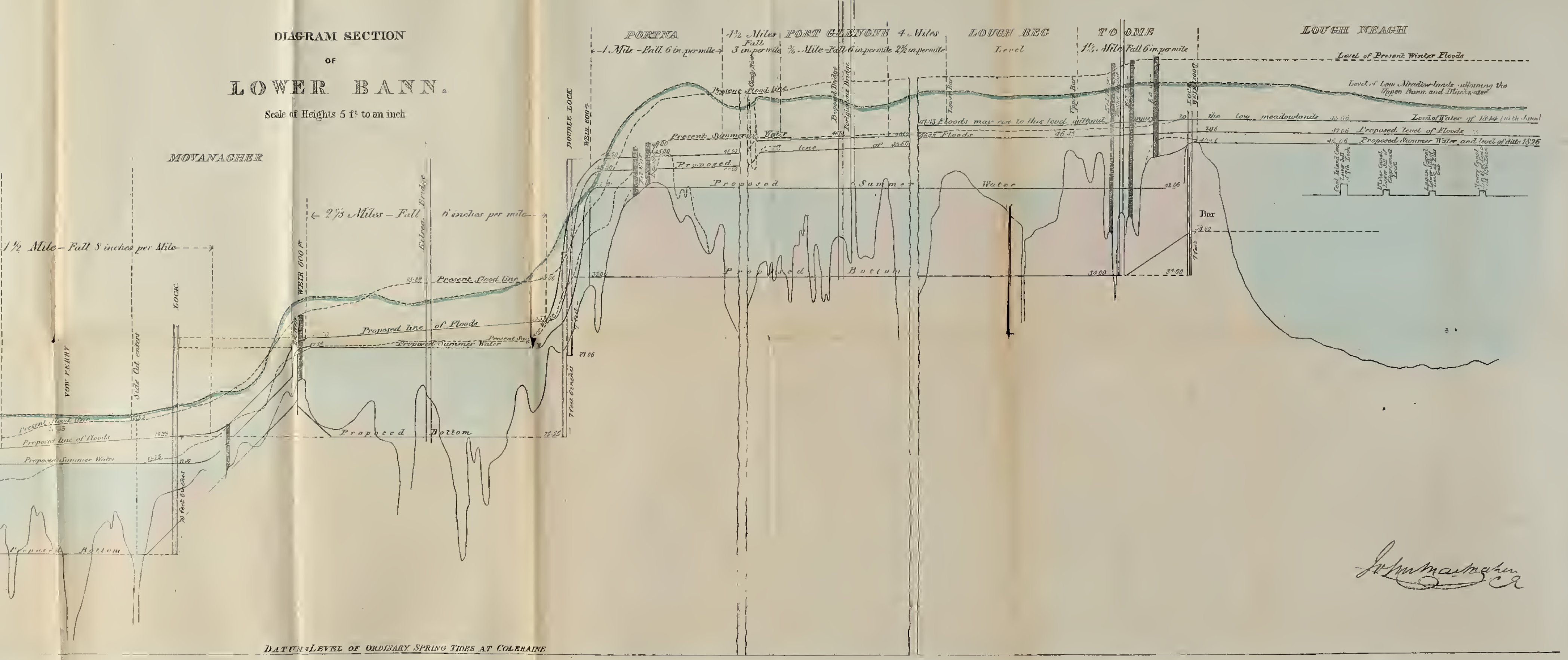
LOWER BANN.

Scale of Heights 5 ft to an inch


MOVANAGHER
PORTNA
PORT GLENONE
LOUGH BEG
TOOME
LOUGH NEAGH
1½ Mile - Fall 8 inches per Mile
2⅞ Miles - Fall 6 inches per mile
1 Mile - Fall 6 in. per mile
4½ Miles Fall 3 in. per mile
¾ Mile - Fall 6 in. per mile
4 Miles 2½ in. per mile
Level
1¼ Mile Fall 6 in. per mile
VOW FERRY
Side Cut enters
LOCK
10 feet 6 inches
WEIR 600 ft
Kilrea Bridge
DOUBLE LOCK
WEIR 600 ft
7 feet 6 inches
Present flood line
Proposed line of Floods
Proposed Summer Water
Present Summer Water
Proposed Bottom
Proposed Summer Water
Proposed Bridge
Portglenone Bridge
Lower Bar
Upper Bar
Bar
LOCK
WEIR 200 ft
47.43 Floods may rise to this level without injury to the low meadowlands
46.45 Floods
46.15
Level of Present Winter Floods
Level of Low Meadow-lands adjoining the Upper Bann and Blackwater
Level of Water of 1844 (10th June)
47.06 Proposed level of Floods
46.06 Proposed Summer Water and level of ditto 1826
Coal Island Canal Lower Sill of 7th Lock
Ulster Canal Lower Sill of Charlemont Lock
Lagan Canal Lower Sill of Lock at Ellis Gut
Newry Canal Lower Sill of 15th Lock
33.28
35.06
31.00
34.00
34.00
27.06
27.56
25.55
19.28
17.55
32.06
38.02
DATUM=LEVEL OF ORDINARY SPRING TIDES AT COLERAINE

John MacMahon C.E.

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DRAINAGE

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LOUCH NEAGH DISTRICT.

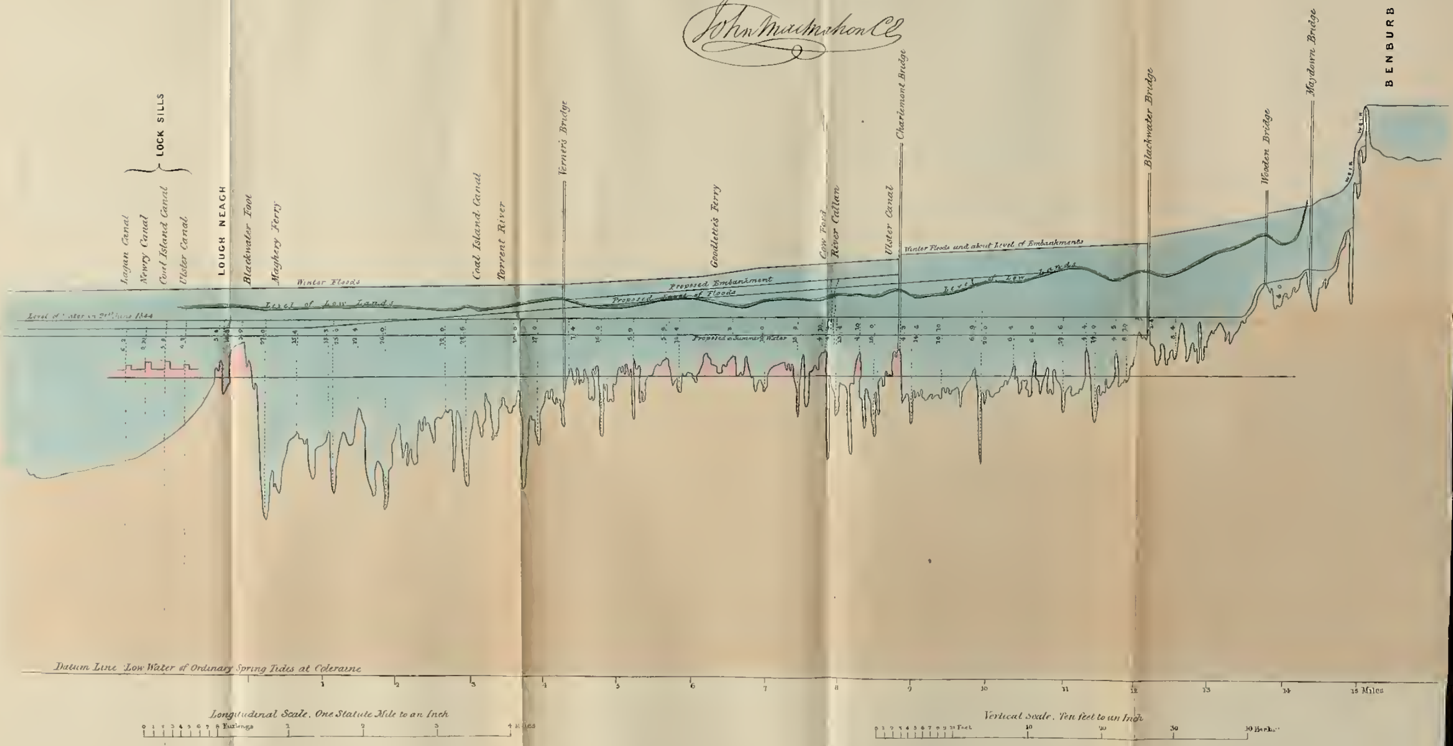
LONGITUDINAL SECTION OF THE

RIVER BLACKWATER,

FROM

LOUGH NEAGH TO BENBURB.

John MacMahon CE



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the eastern face of that range of hills, extending from Slieve Gallion, south and west, to Pomeroy and Barrack mountain, and including in its basin of 161 square miles, Moneymore, Cookstown, Stewartstown, and Coagh, enters the lake a short distance to the east of the hamlet of Ballinderry.

BLACKWATER RIVER.

The Blackwater River, whose rain basin extends over 618 square miles of the district, has its source near Fivemiletown, in the County of Tyrone, on the borders of Fermanagh, and receives in its progress to the lake all the tributary streams of that extensive district, including within its limits, Clogher, Ballygawley, Emyvale, Glasslough, Monaghan, Caledon, Keady, Armagh, Dungannon, Donoughmore, Blackwater Town, Moy, Charlemont, and the streams of the Callan Tall and Torrent Rivers, as also the trade waters of the Ulster Canal, which enter it at Charlemont, and of the Coal Island Canal, which joins it about 3¼ miles above its entrance into Lough Neagh, at the Blackwater foot.

This river is the largest and most powerful tributary to Lough Neagh. Between the Lough into which it enters at Blackwater foot, and Charlemont, it is similar in character and condition to the Upper Bann, the rise being only about two inches. And the channel for the greater part of this distance is wide and deep, and free from obstruction, except as hereafter described.

The bar formed at the Blackwater foot is a great obstruction to the free out-flow of the river water during the *summer floods*, and was almost an insurmountable difficulty in the way of navigation, until the construction of a short lateral canal, called the Maghery Cut, opened a passage (between the river and the lake,) for boats drawing 4 feet 6 inches of water in summer, at the east end of Derrywarragh Island. From the bar to Verner's Bridge the river is wide and deep; but between this point and Charlemont, the out-flow of the flood waters, and the navigation of the river, are much impeded by shoals and inconvenient windings.

There is a very large extent of valuable meadow land on the banks of this reach of the river, but little elevated above the summer water; and being thus under the influence of the floods of the Lough, it is subject to all the evils that follow from frequent, and almost periodical inundations.

Above Charlemont the river is much narrower, and the meadow lands are in some measure defended from the mischief arising from sudden floods, by embankments; but these have not been as useful as they should, from their general mal-construction, and injudicious position. There are two canal navigations connected with this river, namely, the Coal Island, and the Ulster Canals; the former entering about 5 miles up from the Lough, and the latter near to Charlemont.

The Torrent River enters the Blackwater, a short distance above the entrance of the Coal Island Canal, and has on its margin large tracts of flooded lands.

The Callan enters on the east side of the river, about one mile below Charlemont. This tributary is of considerable magnitude, and is joined by the Tall, about a mile up from its confluence with the Blackwater. There are large tracts of meadow land lying along the banks of both these rivers, much injured by flood water, which lies upon them for months every season. An attempt has been made to render the Tall exempt from the sudden floods of the Callan and Blackwater, by flood gates placed at its junction with the Callan; but this as well as every other attempt to relieve these lands will be ineffective, while the winter waters of Lough Neagh rise to their present height. The floods, as already stated, command all the low grounds on the banks of these rivers, and cover them for the whole of the winter season, several feet in depth.

Verner's Bridge, which crosses this river, may be said to be of recent construction; it has two masonry abutments, with a wooden carriage-way, resting on piles

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DRAINAGE

Under the Act 5th & 6th Vic Cap 89

LOUGH NEAGH DISTRICT.

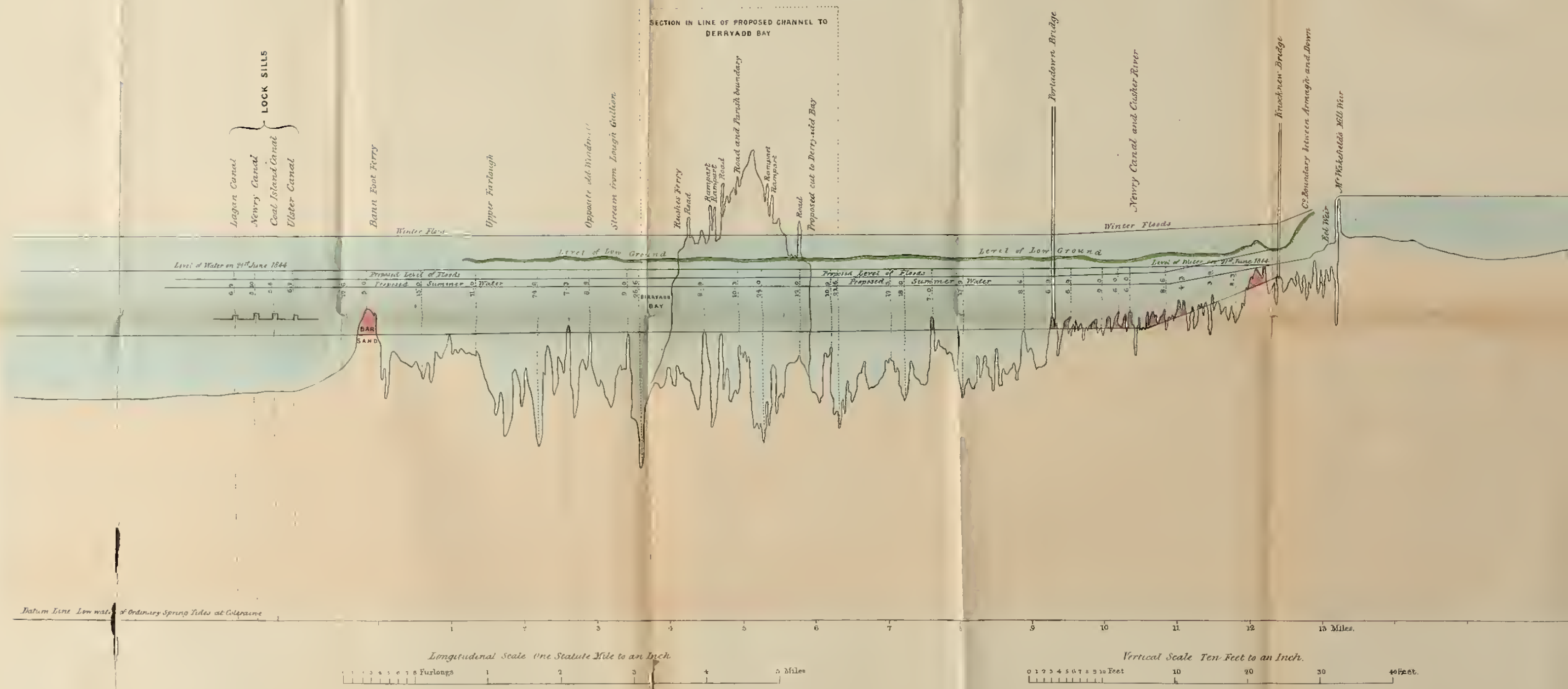
LONGITUDINAL SECTION OF THE

UPPER BANN RIVER,

FROM

LOUGH NEAGH TO Mr. WAKEFIELD'S MILL WEIR.

John MacMahon CE



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driven into the bed of the river. The distance from abutment to abutment is 110 feet.

This bridge, like that at Toome, is private property, for the use of which the public pay a toll.

Charlemont Bridge is a wretched specimen of bridge architecture, and is in so dilapidated and dangerous a condition, that it is a subject of wonder it should be so long suffered to occupy the important position it does, on so great a public thoroughfare.

UPPER BANN RIVER.

The Upper Bann River, which has a catchment basin of 208 square miles, rises within a short distance of the Irish Sea, in the heart of the Mourne Mountains,* and flows in a north-west direction by Rathfriland, Banbridge, and Portadown, a short distance above which it is joined by the waters of the Newry Navigation, the trade of which is carried in its course from thence to the Lough at the Bannwater foot.

On the banks of this river there are very extensive tracts of low land adjacent to its course from the Lough to where the Newry Canal enters it, subject to most destructive floods, which continue on the lands for a great portion of the year; and when they are withdrawn by the falling of the waters of the Lough, by absorption and evaporation, the most disastrous consequences to the health of the surrounding population are known to follow their retirement.

The river from the Bannwater foot to White Coat point, where the Newry navigation enters it, a distance of 11½ miles, may be taken as an expansion of Lough Neagh as to the level of its water, the ascertained difference in the distance stated scarcely amounting to two inches; and, as in general, the low lands in its vicinity are not much raised above the level of summer water, they are completely under the influence of the Lough, and are therefore, during the winter, submerged to a depth varying from 1 to 4 feet.

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* A large reservoir, Lough Island Reavy, has been constructed near its source, and to some extent prevents the evils of sudden floods, by accumulating them.

The shoal at the Bann foot, where that river enters the Lough, is one of very considerable extent; it is formed by the deposits of the river in floods, and by the opposing action of the lake waves upon the sandy beach in its neighbourhood. The depth of water on this bar varies frequently; during the summer of last year, there was but 3 feet 6 inches of water upon it; in 1826 but 1 foot 11 inches; in 1828 the depth was increased, principally by dredging, to 4 feet 6 inches; and in 1829 it was reduced to 3 feet 1 inch; the material, however, of which it is composed, (sand and mud) is easily removed by dredging.

The course upwards to Portadown is rather tortuous, but the channel is wide and deep. At Portadown, and from thence to the Newry Canal, the width and depth diminish greatly; and there are numerous shoals, on some of which there is but little water.

The Cusher River joins the Bann near the entrance of the Newry Canal, and for four miles of its course the flooded lands are of great extent, chiefly caused by the rise of the water in Lough Neagh, which extending up this river prevents the free discharge of its waters, compelling them to rise, and overflow the adjoining lands. This river (Cusher) has recently been improved by the Duke of Manchester; but while the injurious influence of Lough Neagh remains unabated, these improvements are in a great degree rendered of but little value.

Lough Gullion, which covers about 300 acres of valuable land, is situated near Bann Foot, and from the winding of the river, it is almost enclosed between its course and the shores of Lough Neagh. A spirited attempt was made some years ago to drain this Lough by mechanical means, but the high floods of the Lough and river created such a head of water as overpowered the defences erected against them, and placed this fertile basin again under the dominion of the floods. And

I feel confident that every similar attempt, within the limits of a reasonable outlay, must fail, while Lough Neagh rises uncontrolled during the winter season.

Added to these, the several streams which pass by Gleneavy and Crumlin, discharge the waters of the eastern side of the Basaltic Hills, whose sloping sides here gradually dip to the Lough, but whose more precipitous and picturesque escarpment, forms a remarkable feature in the landscape of Belfast. The Sixmile water at Antrim, and the Main River flowing from the north due south, passes near to Ballymena, through Randalstown, into the Lough at Antrim Bay.

There are also numerous drains and ditches which have been made for conveying the water off the meadow lands, quite inoperative; the most important are those connected with Portmore Lough, and the Closet River; but all more or less ineffective, from the same cause, namely, the uncontrolled rising of the floods of Lough Neagh.

All these, and numerous minor streams, pour their never-failing supplies into this great recipient; and it is, as before stated, a remarkable fact, that the accumulated waters of so immense a district of country, are discharged by the Lower Bann River alone.

The Lough itself (for our purposes in this part of the inquiry) is to be looked upon in no other light than that of a great compensating reservoir, formed by nature to counteract the destructive effects which, but for its intervention, must result from so great a mass of water being forced to pass through the limited and obstructed channel of the Lower Bann. And notwithstanding the great area of the Lough, say one twelfth that of the catchment basin, the floods rise in winter from 4 to 6 feet above the level of its summer water, and spread over a breadth of country exceeding 25,000 statute acres in extent, in addition to the Lough.*

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* From this short statement, the necessity for avoiding any sensible diminution of the area of the Lough, and keeping it at or about summer level, is abundantly evident.

Such are the present circumstances and condition of Lough Neagh, and I regret to say, that if we seek to obtain a knowledge of how this great sheet of water stood in former times, we are met by opinions and theories of so contradictory a character, that little or no practical good can result from our labours.

Captain Portlock, in his excellent Geological Report of the counties of Londonderry, Fermanagh, and Tyrone, says, the Lough is apparently the result of a great crack and subsidence of the strata; and, judging from the Lacustrine remains found in its vicinity, he concludes that its former level, as well as that of its neighbouring lough, Lough Beg, was from 10 to 30 feet higher than at present; at the same time he admits, that the trunks and stems of trees found in the clay adjoining, must either be drifted there and sunk into the soft mud, or silted up with mud after their destruction. In either case it will imply a rise and fall in the waters of the lakes, at a range of levels considerably below his minimum standard.

Francis Hutchinson, Bishop of Down and Connor, observes, in a pamphlet published by him in 1738,—"That the waters which flow from so many sources, could not be discharged by the single outlet of the Bann; but must, without steps are taken to assist the discharge of the waters by clearing the obstructions of the river, be annually accumulated, to the great detriment of the lands around," and as a proof of this accumulation, he mentions "that one church, Ballyscullen, was not only encompassed by the floods, but that a great part of the parish had been drowned; that great tracts of rich land, once adorned with trees, were covered; and that a fisherman having twice removed his habitation, was about to do so again, complaining that he knew not where to place it, *for the Bann followed him*."

It is difficult where circumstances have occurred so widely separated by time as those to which Captain Portlock and the Bishop of Down and Connor refer, to assign a true value to the views of either; but as his

Lordship states facts of which he was personally cognizant, and in the investigation of which he took a deep interest, whilst resident at Portglenone, on the margin of the waters he so graphically describes, and as his statements are supported by other competent opinions, and more particularly by official documents furnished to the Directors-General of Inland Navigation, in the year 1826, by their then Engineer, the late Mr. Killaly (a close and accurate observer), I feel confident that we are borne out in the first conclusion we have come to, that the waters of these Loughs, even between 20 and 30 years ago, stood at a lower level than they do at present.

SECOND.

PRESENT GENERAL MEANS OF TRANSIT.

With respect to the artificial navigations which unite with Lough Neagh, it will be seen, on reference to the diagram map of the district, that there are four important branches of inland navigation already connected with this great water, and a fifth proposed, which is treated on in detail in this Report, that is, The Lower Bann from the Lough to Coleraine.

The first of these is the Lagan Canal, by which a junction is effected between the waters of the Lough and an arm of the North Channel at the Port of Belfast.

The second, the Newry Canal, which, making use of the deep channel of the Upper Bann for a considerable distance from Lough Neagh, also effects a junction with the sea by entering into Carlingford Bay at Newry.

Third, the Tyrone, or Coal Island Canal, which, leaving the Blackwater about 3¼ miles above the confluence of that river with the Lough, terminates at the town of Coal Island.

Fourth, the Ulster Canal, which also takes its departure from the Blackwater (at Charlemont,) and passing in a south-western direction, near the towns of Monaghan and Clones, joins Lough Erne, in the neighbourhood of Wattle Bridge.

The first of these, the Lagan Navigation, was commenced by the Corporation for promoting and carrying on Inland Navigation in Ireland, under the authority of an Act of the 27th Geo. II., chap. 3 (1755), entitled, " An Act for making the River Lagan navigable, and opening a passage by water, between Lough Neagh and the town of Belfast, in the county of Antrim," by which, certain local duties on ale and whiskey were granted, the produce thereof to be applied to the formation of the navigation. The works continued under the superintendence of a Public Board until the year 1780, up to which time the produce of the local duties and a loan amounting to £10,000, were expended on the works.

In the year 1779 and 1780, a second Act was passed, entitled, " An Act for amending and explaining the several laws made in this kingdom for carrying on the Lagan Navigation," under the provisions of which, such persons as might advance money on the security of the duties and tolls for carrying on the navigation, were created into a corporation, with powers to complete the works. And under this Act, the first Marquess of Donegal having, whilst the former Act was in force, lent £7,815 to the undertaking, advanced the further sum of £62,000, late currency, towards the completion of the navigation. The works were first commenced in 1755; resumed, with the money obtained from Lord Donegal, in 1783, and completed to Lough Neagh in 1793.

In the year 1810, part of the navigation lying between Belfast and the summit, having got very much out of repair, a number of the merchants of Belfast purchased the greater portion of the interest held by the then Lord Donegal in the concern, with a view to its restoration, and since that time it has been progressively improved; several of the locks and weirs have been reconstructed, and others repaired, the bed of the river deepened, and bye cuts made on every level, and several other useful changes effected, from which the trade now derives much advantage.

Additional Parliamentary powers having been obtained in the Session of 1843, it is stated to be the intention of the company to carry out several other measures for the improvement of their undertaking, such as the separation of the navigation from the river, in certain necessary cases, the remodelling of the Union Locks, mainly to effect a saving in water, and the deepening the reach of the river from the first lock towards Belfast, so that Lighters with their usual cargoes of from 50 to 70 tons, and drawing from 4 feet 6 inches to 5 feet water, may pass at half neap tides. These are among the number of the improvements which are to be carried out in the course of the next season.

"It is satisfactory to learn that the trade on the Lagan Canal is improving, and that it is very little affected by the rivalry of the Ulster Railway; light goods were rarely carried on the Canal, *and for all heavy goods it is expected it will still command a preference.*"

Such is the statement and opinion of a very intelligent and experienced person, Mr. M'Cleery, Engineer to the Lagan Navigation, in the justness of whose views, in this respect, I fully concur, having myself long entertained a firm conviction, that *Canals* and *Railways*, in the same locality, are not necessarily to be looked upon as *competing highways.*

The dimensions of the canal admit boats of from 70 to 80 tons burden; it is 28 miles in length, and has 187 feet of lockage. The upper cill of the western lock of the Summit, stands 73 feet above the lower cill of the lock entering Lough Neagh, and the upper cill of the eastern lock, on the same level, stands 114 feet above the lower cill of the first lock, next adjoining Belfast.

In dry seasons the supply of water is very limited, from which the trade suffers inconvenience.

The Lighters carry general cargoes through Lough

Neagh, to the ports on its shores, and to Maghery, and Coal Island, and by the Ulster Canal to Moy, Caledon, Monaghan, Clones, Belturbet, and Enniskillen, and on some occasions, of rare occurrence, down the Lower Bann, to Portglenone and Portna; being however obliged to lighten, even with a considerable accession of flood water, across the Bars at Toome, and at Portglenone, and of course to discharge at Portna, whether the goods were for Glenstall Mills, Ballymena, or Kilrea, there would, says an intelligent person connected with the carrying department of these Northern Navigations, be a considerable trade on this river (the Lower Bann) if it were always navigable, *even to Portna.*

The traffic on the Lagan in 1836=44,700 tons; 1844=46,895.* For the toll charge the entire length, 28 miles, (*See Appendix, No.* 5.)

The second artificial Navigation referred to, the Newry Canal, extends from Lough Neagh, at the Bann Waterfoot, to the town of Newry. The deep channel of the River Bann is used for about 11½ miles of its length, from the Lake to White Coat point; from thence to Newry, a distance of 19 miles is attained by a still-water canal, carried over a low summit of the country, standing about 22 feet above the waters of Lough Neagh, and 67 feet above low water in Carlingford Bay, to which the sea reach of the canal below the town is carried.

The portion of the navigation, extending from the lake to Newry, was completed nearly 100 years ago, and that from the town to the sea between 60 and 70. The whole of these works were originally constructed by Parliamentary grants; and between the years 1800 and 1812, there was a further sum of £54,516 5*s.* 9*d.* expended on repairs, by the Directors-General of Inland Navigation, of which sum, the accumulated tolls, amounting to £16,082 19*s.* 8*d.*, formed a part.

The Local Commissioners in charge of this undertaking, are at present engaged in extending the canal from Fatham Lock to Doyle's Hole, a favorable reach in the estuary; and in constructing a new entrance-lock, which is in a position to admit vessels drawing 14 feet at the high-water of neap tides.

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* This year, it is expected, the Traffic will amount to 50,000 tons.

The completion of the inland reach of this canal, about the year 1750, was considered a great national benefit. Its trade continued prosperous for several years; but, owing to mismanagement (from the ill construction of the original Commission), the works were let to go out of repair, and the revenue, in consequence, fell off. It is, however, now better regulated, and the trade is on the increase.—(*See Details of Traffic, in Appendix*, *No.* 6.)

The third Navigation named above, is the Tyrone or Coal Island Canal, and the Maghery Cut; these were solely constructed at the public expense, the object being to afford a cheap mode of transit for the mineral products of the Tyrone coal field.

This navigation is but 4⅛ miles in length; the water surface in the basin, at its summit, stands 57 feet above the bottom sill of lowest lock, next the river Blackwater, which it joins about 3¼ miles from Lough Neagh.

The Maghery Cut, an adjunct of this canal, was made, subsequent to its formation, for the purpose of allowing loaded vessels to enter the lake, and avoid the bar at Blackwater foot, on which there are but 22 inches of water in summer.

The trade of this short canal is improving. In 1837, the gross amount of imports and exports was 8,200 tons, and in 1844, it amounted to 13,260 tons.—(*See tables of details in Appendix*, *No.* 7.)

The fourth Navigation, the Ulster Canal, leaving the Blackwater at Charlemont, (the point at which that river ceases to be navigable for the ordinary-sized trade boats,) passes in a south-western direction, near the towns of Caledon, Middleton, Monaghan, Smithsboro', and Clones, and joins the waters of Lough Erne, in the neighbourhood of Wattle Bridge.

The length of this canal is 48 miles; its course is through a highly cultivated agricultural country, "swarming with an intelligent and industrious population." Through its means the waters of Lough Erne and Lough Oughter, having a coast line of 203 miles, are connected with Lough Neagh, the coast line of which is little less than 100 miles, and their united direct navigations when developed and increased, by the Lower Bann being rendered navigable, will be fully equal to 165 miles, altogether 468 statute miles.

This canal being but a few years opened, the trade, as might be expected, is not yet fully established. The effecting of an entire change in the traffic current of an extensive district, and the getting up of suitable establishments for its accommodation, requires much time to accomplish, and consequently we cannot be surprised to find that the receipts are low.

The ultimate success of the undertaking, however, should not be doubted; the country will do its part, provided the requisite facilities are afforded, as a proof of which, in 1843 the traffic was but 13,371 tons, and in 1844 it was 17,585 tons, showing an increase of one-third in tonnage, in the short space of one year. notwithstanding that the trade was interrupted for some short time, owing to want of water.

Third.

THE SANITARY EFFECTS OF LAND DRAINAGE.

This important subject has not until within a few years been so much insisted upon, or set in such clear light as it deserves and admits of; neither does it appear now to be so generally acknowledged and made public as it ought to be, so that even those proprietors who feel a real desire to be useful to their tenantry, are not aware how much they can promote their comfort and welfare, by encouraging the drainage of the flooded lands on their estates, and thus contribute to prolong the enjoyment of health to the poor dependent upon them, and enable them to turn to useful account that labour which has been aptly termed "their only marketable commodity."

The mass of medical testimony brought forward on this point in the late Report from the Poor Law Commissioners, on an inquiry into the sanitary condition of the labouring population of Great Britain, is so extensive and convincing, that no unprejudiced person, who examines that valuable work with attention, can refuse to the sanitary effects of land drainage, a conspicuous position amongst the incentives for the carrying out of such useful operations.

Those valuable records are further corroborated by the opinion of Professor Johnston, who, in his excellent work on Agricultural Chemistry, published in 1844, after speaking of drainage as peculiarly useful to all classes of society, states, that not only is drainage equivalent to a change of climate in reference to the growth and ripening of plants, but it is so also in reference to the general health of the people, and to the number and kind of diseases to which they are observed to be exposed; and in illustration of these facts, we quote the convincing observations of Dr. Wilson, on the comparative state of the health of the labouring population in the district of Kelso, during the last two periods of ten years.

In this paper, published in the Quarterly Journal of Agriculture, he has shown that fever and ague, which formed nearly one half of all the diseases of the population during the former ten years, have almost wholly disappeared during the latter ten years, in consequence of the general extension of an efficient drainage throughout the country, while at the same time the fatality of disease, or the comparative number of deaths from every hundred cases of serious ailment, has diminished in the proportion of 4·6 to 2·59.

Such beneficial results, though not immediately sought for by the practical farmer, are yet the inevitable consequence of his successful exertions. Apart therefore from mere considerations of pecuniary profit, a desire to promote the general comfort and happiness of the entire inhabitants of a district may fairly influence the possessors of land to promote this method of ameliorating the soil, while the whole people, on the other hand, ought gratefully to acknowledge the value of those improvements, which at once render *our homes more salubrious, and our fields more fruitful.*

In No. VIII. of the Appendix to this Report will be found a brief account of some valuable information obtained on this subject, by the Commissioners of Drainage, not only with reference to this District, but several others in Ireland.

FOURTH.

PROPOSED MEASURES OF IMPROVEMENT.

Before entering upon a description of the measures of improvement now proposed, it may be desirable to advert to those which have heretofore been contemplated, and which are briefly described in the following

EXTRACTS

FROM REPORTS OF ENGINEERS AND OTHERS, IN REFERENCE TO LOUGH NEAGH AND ITS SUBSIDIARY RIVERS,

WITH SUGGESTIONS AND PROJECTS FOR THEIR IMPROVEMENT.

The evils arising to the country from the annual overflowing of the waters of Lough Neagh and its subsidiary rivers, engaged the attention of the owners of the contiguous lands, (if not before) at a very early period of the eighteenth century.

1738.

The Bishop of Down and Connor, in the pamphlet adverted to, shows that attempts had been made previous to his time, to reclaim lands in the neighbourhood of these loughs, which had been subject to annual submersion; and although what had been done was not maintained, the Bishop speaks of the effort, in the following glowing terms of praise,—"Thanks be to God we are not come to that grievous pass yet; our overflowing river hath received one noble check by the ever to be honored Mr. Dawson, who, before he died, did not only recover much noble land from it, near to which he built his useful barrack, but convinced us that by diligence and labour, all the 14 rivers may be made to pass through the same channel, though *strait and narrow in many parts.*"

Through the Bishop's efforts a project was got up for removing some of the obstructions in the Lower Bann, so as to take off the surplus waters of the lake; the measure was very warmly supported by those interested in the reclamation of the injured lands, and having great confidence in the Bishop's foresight, preparations were actually made for commencing the works, by clearing the river at Portna, when his lamented death terminated the speculation.

The contributors, though confident of success whilst the Bishop lived, considered the undertaking of too great magnitude to venture on, without the assistance they felt they could confide in.

From the time here referred to, to the beginning of the present century, we can find little or no trace of any attempt being made, or any Engineering notice whatsoever taken of the improvement of the Lower Bann, either as a Navigation or as a Drainage conduit. Yet, within the period referred to, we see the sea approached from the lake by two artificially-forced navigations, in which are involved the various expenses incidental to the passing the summits of the country lying between Lough Neagh, and the Ports of Belfast and Newry; whilst the available natural discharging channel, the Lower Bann, through which a mighty volume of water is daily passing to the ocean, is permitted to lie neglected, although any navigation effected in conjunction with it, would have *the Lough itself as a summit level, and an inexhaustible reservoir.*

1804.

Sir Charles Coote, Bart., in his Statistical Report of the County of Armagh, drawn up in the years 1802 and 1803, and published for the Royal Dublin Society, speaking of the Navigations connected with Lough Neagh, asks leave to make the following "remark on the line which appears most favourable for an effectual navigation from the sea to the lake, and by which a communication would be procured with the remote counties of Ulster. Every observer will allow that this line should be *the valley through which the Lower Bann* flows to*

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* The Lower Bann is not connected with the County of Armagh, the statistics of which Sir Charles Coote might have limited his remarks to. The advantages derivable by the public from rendering this river navigable, must, therefore, have appeared in very strong light to Sir Charles to induce him to advocate the measure as he has done.

Coleraine. The entire line of the Counties of Antrim and Londonderry would thus be benefitted, and the expense, comparatively with the advantages to be derived, would be trifling."

1811.

The Rev. John Dubordieu, Rector of Annahilt, engaged by the same scientific body, (The Royal Dublin Society,) reported on the statistics of the County of Antrim in the year 1811. And in observing on the injuries done to the surrounding country by the floods of Lough Neagh, says, "even to reduce the body of the water, during the summer season, so that the basin of the lake would have a capacity to hold a great part of the winter floods, without rising above the present summer level, and by that means to prevent the usual accumulations of the winter, would be a great object to landholders, whose properties border upon the lake; and this project, which if once carried into execution, would be so very beneficial, does not seem unfeasible."

Mr. Owens, who completed the Belfast Canal from Lisburn to Lough Neagh, was employed by a former Lord O'Neill, to examine this project; he recommended a wide cut on the Antrim side of the river, from Brockish Bay into Lough Beg, at a cost of £10,000, so as to effect the lowering of *the Lake* 15 inches, the assumed difference of level between the two waters, which it was expected would uncover 1,666 *acres of the lough shore.*

The more effectual drainage of the lough, Mr. Owen looked upon as a work not to be accomplished within reasonable limits as to cost, and he concludes his remarks on this subject by saying, "I am decidedly of opinion, that if £100,000 were expended on even a partial draining of the lough, it would not be completely done. The Rev. Mr. Dubordieu on this observes, that if success was to attend the attempt, the sum mentioned would be well disposed of in effecting such a work.

1812.

Mr. Thomas Townshend, an Engineer of much experience, engaged under the Bog Commissioners, in the Counties of Armagh, Tyrone, Antrim, and Londonderry, examined into the circumstances connected with Lough Neagh and the Lower Bann, with a view both to draining and to navigation. In his Report to the Commissioners, printed by order of the House of Commons in 1814, he justly observes, that "the Bann is formed by nature for a navigable river, not being one gradual descent, but in level reaches; the fords or falls are short, and few in number, so that with the aid of a few locks at those places, the materials for which are just on the spot, the river immediately becomes navigable. There is more than sufficient depth of water in the river for the navigation of barges between one fall and another."

To carry out his project, he recommends that 8 feet of the Portna fall should be taken up, and the fords and shoals, from thence to Lough Neagh, to be also sunk as much as may be requisite, to give the proposed sinking at Portna its due effect on the surface of the lough. The cost of this work is estimated at £75,000, and the improvements he proposes in the river, from Portna to Coleraine, at £25,000, that is, £100,000 for the works contemplated from Toome Bar, to the Cuts or Salmon Leap, near Coleraine.

~~1822.~~ 1828

The late Alexander Nimmo, an Engineer of a profound and original mind, being consulted in the year 1822, by the subscribers for improving the Newry Navigation, mainly as to its supplies of water, states,—

"Now, it appears to me, that this navigation is capable of a singular improvement, the effect of which would be of the greatest possible consequence, not only to the trade of Newry, but to all the country round Lough Neagh. The summit level of the canal is only 21 feet above the lake, and 3 miles long; the soil is mostly soft, much of it bog, and of little relative value. It would be a matter of no great expense or difficulty to cut it out, and to bring the surface level of Lough Neagh through the valley towards Newry, giving a supply of water to the canal, and our proposed Lower Navigation, that would be abundant and inexhaustible, saving, also, the passage of three locks on one side, and four on the other. I should propose to bring that level on to the town, which the ground readily admits of. And thus the whole of the inland trade of Newry may be done without lockage at all; and the cut may be of such dimensions as to admit of steam vessels, so as to excel any kind of land carriage, even in expedition.

"A slight improvement on the Lower Bann would extend this level navigation to Portglenone, 60 miles, in a straight line, from Newry. We could obtain* a command of Lough Neagh, such as to run it down some feet in the end of summer, and to keep its winter rise to the present summer level; thus saving from being flooded 6,000 acres of land; and we would bring a water-power into Newry of, say, one-sixth of the discharge of the Lake, with 45 feet of fall, which I estimate at 3,000 horse-power, being more than that of all the steam engines of Glasgow.

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* That is by the Lower Bann.

"The reservoir covers 100,000 acres; and the value of such a power, in a seaport, and in the midst of a rich, populous, and busily-manufacturing country, is not to be easily calculated—indeed, the like is not to be found in Europe."

1834.

Mr. J. O. Woodhouse, of Portadown, published Observations on the overflowing of Lough Neagh and its rivers in winter, and the present state of the navigation thereof, and suggestions for preventing the overflow, and for improving the navigation.

This gentleman, whose local knowledge is allowed to be very extensive, says, "That the mischief and injury done to the land, by the overflow of the water, is incalculable; no kind of agriculture can be attempted; the plough is unknown in those lands; and no person would dare to erect a habitation within reach of the annual inundation. Year atfer year they remain almost a desert, giving no employment to the labourer, of very little value to the owner, and extremely prejudicial to the health of the inhabitants of the neighbourhood." In the careful perusal of Mr. Woodhouse's pamphlet, the reader will discover many circumstances of much interest, in reference to this inquiry.

1836.

Sir John Macneil, an Engineer of considerable celebrity, surveyed the district, and reported to the Committee of the Lough Neagh Improvement Company, "on the means of making the Lower Bann navigable, and of preventing the waters of Lough Neagh from rising above the summer levels." From this Report, I take leave to make the following extracts:

"Though the prevention of the overflow of the lake, and the opening of the navigation of the river, affect different interests, and might be executed by different parties, on the whole it will, I think, appear evident, that a very considerable saving will be effected, and all chance of collision avoided, by the prosecution of both conjointly, and by the same parties."

"No one who has witnessed the vast importance attached to navigable rivers in other countries, or observed the enormous sums which are profitably spent in making even small streams available for the purposes of navigation, can trace the course of the Lower Bann, passing, as it does, through a rich and fertile country, and approaching within a few miles of several populous towns, and not be struck with the neglect which its great capabilities have experienced up to the present hour. The project, though long a subject of contemplation and frequent discussion, has unfortunately not been matured, owing to parties who suspected their interest might be injured by the alteration, starting difficulties and objections strong enough to prevent its being carried into execution; these difficulties and objections are, however, mostly imaginary, and such as are not so, may certainly be overcome. The proposition may be carried into effect, in my opinion, without affording the slightest cause of complaint, either to the proprietors of the fisheries, to the land owners along the banks, or to any other really interested party whatever."

Sir John entertains an equally favourable opinion with Mr. Townshend, as to the facility of converting, at a comparatively small outlay of capital, the Lower Bann River into a useful navigable communication, although he differs with that gentleman as to the means of effecting it, and also the contemplated interference with the level of the waters of Lough Neagh.

On the overflow of the lough, he observes, "The constant reduction of the winter floods of Lough Neagh, to the uniform level at which the lake usually stands during the summer months, must be attended with important consequences to all the land occupiers on its shores;" and he further adds,—"Though the quantity of water which comes down the supplying rivers is at times very sudden, and very great, yet being spread over the vast surface of the lake, it never produces any great or sudden rise. The lake being generally three or four months before it comes to its greatest height, at which time it stands about six feet on the bar of Toome, it usually takes two months to reduce it to ordinary summer level, after the winter rains have ceased."

"The great obstruction to the discharge of the water, and principal cause of the rise of the lake in winter, is the very contracted channel, and the bar of rocks at Portna. If these checks were removed, there is very little doubt it would prevent the water rising in winter to any thing like what it does at present; but to do this without precaution, would lower the summer level, and be extremely injurious to the navigation both of the lake and of the river above Portna."

Sir John estimates the expense of keeping Lough Neagh permanently at summer level at £71,221, and the improvement of the navigation of the Lower Bann at £55,760, gross £126,981, that is, carried out separately; but if drainage and navigation were combined, the cost would be £104,660, thereby producing a saving of £22,321.

1838.

Mr. Gregory also examined this vast project; but I have not met with his Report, and therefore beg to refer to the valuable testimony of Mr. John Hancock, J.P., Agent to Lord Lurgan, given before the Land Commission, in which the substance of Mr. Gregory's general opinions on this important subject are stated, and which goes to prove that he concurs fully with those who preceded him, as to the destructive effects of the winter floods, and the feasibility of the projects submitted for their prevention.

1839.

Mr. Thomas Rhodes, an Engineer of extensive practice and long experience, says, in his Report to the Board of Works, and to the Under Secretary for Ireland, "that on considering the project of lowering the surface of the lake, and reducing the winter floods to or near the summer level, I am decidedly of opinion, that this speculation will amply repay the outlay of the capital necessary for the completion of the works, and that it would be a great benefit to the country, as, by these means, from 20,000 to 30,000 acres of land and bog might be reclaimed and brought under cultivation." And to the Under Secretary he says,—"Looking at the prospect of lowering Lough Neagh, and taking off the superabundant water, and by these means reclaiming such large tracts of land for the purposes of cultivation, rendering the river navigable, and bringing the water-power into operation, I am immediately struck with the wide field which would be opened to enterprise, the stimulus that would be given to industry and commerce, and the great benefit that would accrue to the country; and as it partakes of a national character, it well deserves the consideration of the Legislature." It is to be regretted that Mr. Rhodes's survey was not more extended, and taken in more detail. He states Mr. Gregory's estimate of £79,993 : 5*s.* to be sufficient for the purpose; but concludes by proposing certain works at *Portna*, and thence to *Toome* (expressing, however, a doubt as to which place would be most suited for the regulating weir), which he conceives would be sufficient, and would in his opinion be executed for £35,000,* exclusive of the purchase of eel weirs.

1843.

Mr. Francis Giles, C.E., of London, and Mr. Jas. M'Cleery, of Belfast, Engineer for several years past to the Lagan Navigation Company, surveyed the Lower Bann River with a view of converting it into a navigable canal. In explanation of their project, a brief report was published in that year, in which the several obstructions in the course of the river are observed upon, the dimensions of the lateral canals and locks given, and the cost of the whole of the works, including purchase of land, and law, parliamentary, and engineering expenses, stated at £41,000;† the proposed scale of the canal and locks, with one exception, (at the Salmon Leap, near Coleraine,) to be the same as that of the Ulster Canal, namely, locks 12 feet wide, and 70 feet in length from the breast to the angle of the lower gates; the canals to be 18 feet wide at bottom, 42 feet at water surface, and 6 feet in depth, thereby securing a navigable depth of 5 feet.

In the Report, it is proposed to dredge the bars between Lough Neagh and Lough Beg, and also at Portglenone, and to pass the rapids on the river by a lateral canal; the waters to be kept to the required navigable height by a system of lockage.

1844.

The proprietors around the Lake applied by memorial to the Commissioners of Drainage, for the survey, &c., of which this Report is the result.

It is not (I submit) possible to bring forward more convincing proofs than the foregoing extracts afford, of the great value of this truly national measure. We have here the testimony of a number of eminent professional men, and others of great intelligence, called upon at various times, extending over a period of more than

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*I doubt the accuracy of the transcript from which I have made this extract, as Mr. Rhodes is too practical a man to calculate on effecting the drainage of the Lough Neagh district, and the constructing of a Steam-boat Navigation, even to Portna, for £35,000.

† A Prospectus has recently obtained circulation for carrying this Navigation Measure into execution, wherein the estimated cost is £25,000, Engineers, Messrs. Giles and M'Cleery. I regret that I have no means of explaining the startling difference between these two Estimates.

100 years, to consider this important question, and we find all concurring, in the one view—that to free the lands from floods within the influence of Lough Neagh and of the rivers that connect with it, and to render the Lower Bann navigable, would benefit the trade and commerce of the country, increase its productive territory, and improve the health and comforts of its people. It is further satisfactory to know, that there is not one dissentient opinion as to the practicability of the measure.

In the remedial measures I propose to submit, I have endeavoured, at some pains, to reduce the results obtained into as simple and abridged a form as practicable, keeping in view the necessity of affording full explanation of the principles to be adopted, and which I aim at effecting by a recital of facts easy of verification, rather than by the publication of a series of voluminous and abstruse calculations, only comprehensible by men of science, practised in the examination of hydrodynamic questions.

About the year 1831, public attention being a good deal directed to the neglected condition of the extensive district of country on the borders of Lough Neagh, and of the rivers discharging into it, the Government directed, as an important preliminary step, that the Admiralty should have a chart made of the Lough, and the *rise* and *fall* of the flood waters of this great basin ascertained, aware that accurate information upon these two points should form the ground-work for all further Engineering investigation.

The Admiralty Board selected for this service an able and intelligent naval officer, the late Capt. Mudge, then engaged in the Marine survey of the River Shannon; and at the same time employed Lieutenant Graves, R.N., to take the soundings of the Lough, and the chart was, in consequence, published by the department in 1835. On this valuable map the soundings are given in great detail, affording to the engineer data to be relied upon in deciding on the level at which it will be prudent to fix the permanent summer surface of the Lough, and showing further, what is most satisfactory, that nature has presented no obstacle in these great waters to their free and uninterrupted navigation.

To carry out the orders of the Admiralty, with reference to the rise and fall of floods, Captain Mudge selected two central points on the shores of the Lough, one near Langford Lodge, on the east, and the other at Arboe Point, on the west, where he erected his flood guages and established his offices for registering the variation in the heights of the water. The observations were carried on with great particularity from the 19th November, 1831, to 30th July, 1832.

Registries were also kept during a part of the past and present years, by order of the Drainage Commissioners, at Toome Bridge, Lower Bann River, Ellis's Gut, Lagan Navigation, Newry Canal, where it enters the Upper Bann River, and at the Ulster Canal, Charlemont. These notations were carried on in connexion with the other preliminary inquiries incidental to the investigation then in progress.

On a careful examination and comparison of the whole of the tables resulting from these registries, we find that the greatest rise of the waters of the Lough, *uninfluenced by wind*, does not exceed 4½ inches in 24 hours; and there is no record of a continuance of such rise for any successive number of days; thus, the greatest elevation the waters attained in any one month during the examination referred to, did not exceed 16 inches; but a period of 30 consecutive days may be selected within the limits of the inquiry, that is from the 19th of November, to the 19th December, 1831,* in which the floods rose 2 feet 4 inches; of this height 14 inches were attained in the first five successive days, but as the waters fell for several subsequent days, the whole period of 30 days elapsed before they reached the height of 2 feet 4 inches, above adverted to.

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* The floods of 1831-2, are stated to have risen to their ordinary winter heights.

By reference to the table on the diagram map, appended to this Report, and in the Appendix, (No. 10,) it will be seen, as before stated, that the basin of Lough Neagh extends over an area of 1,865 square miles, or 1,193,600, statute acres, of which the Lough itself contains 98,235 acres, nearly one-twelfth the area of the whole catchment basin. Having ascertained from the rain-guage registries kept in the district, that one and a half inches in depth of rain on the surface of the land, occasionally falls in 24 consecutive hours, if we adopt the generally received opinion, that one third of this quantity, in cases of extensive catchments, which on the whole area of this basin, is equal to 2,166,396,000 cubic feet, is discharged superficially by the rivers and streams, into the sea, we arrive at the conclusion, that should this quantity pass into the lake, in the same space of time that the rain guages denote, is allotted to its fall from the heavens, we would have the surface of this great reservoir raised upwards of 6 inches, notwithstanding the discharge by the Lower Bann River, which may be taken in summer, at 100,000 cubic feet per minute.

Captain Mudge's registry gives the observed maximum rise on the surface of the Lough, in 24 hours, at four and a half inches. This rise contains a quantity of flood water, equal to 1,604,691,226 cubic feet, being 561,704,776 cubic feet less than the result which should be produced, by half an inch, or one third the rain that falls in 24 hours on the whole catchment basin, if delivered in that time into the Lough In the mode we adopt here of accounting for this difference, we, in my mind, give the most satisfactory evidence of the accuracy with which the registries have been kept, as well as the justness of those theoretic principles, which assign a limit to the quantity of rain that falls within a given time, and to its distribution after it has fallen.

In this case a great portion of the catchment basin, is very little raised above the level of the Lough, the rain consequently flows slowly off it; and the more elevated parts being the most remote, the surplus waters, arising from the great fall of rain adverted to, require a greater length of time than 24 hours for their passage to the Lough; added to which, the loss from evaporation and absorption being from these causes greater, it can be readily conceived, that the floods in the lake do not rise to the extent due to the fall of rain on the whole catchment basin, but in proportion to the quantity which finds its way into this recipient, within a limited time.

My first object when entering on this inquiry, was to obtain by calm and deliberate investigation, that knowledge of the physical circumstances, and condition of Lough Neagh, of its tributary rivers, and its discharging channel, the Lower Bann, as would enable me to ascertain, with reasonable accuracy, the extent of "the natural and artificial impediments, to the free discharge of their waters."

The results I have briefly described in the preceding part of this Report, and it now becomes my duty to submit to the consideration of the Commissioners, the ENGINEERING MEASURES by which I propose to carry out their instructions, so as to remedy the numerous evils with which this district is afflicted, and which are so justly, and so generally complained of.

Upon reference to the diagram section (No. 6,) of the Lower Bann, the present levels of the waters of the Lough and the several reaches of the River, in their different states, from high floods to ordinary or summer water, may be clearly perceived, and to some extent the causes which produce these results. Upon this section, may also be seen the proposed permanent low water level of the Lough and River, and the probable heights to which future floods may attain; and as the levels of the lowest grounds are delineated on the section, it may readily be perceived, that these floods might rise to a much greater height, without injury to the lands.

Permanent regulating weirs are porposed to be erected at Toome, Portna, Movanagher, Carnroe, and the Cuts of Coleraine, whereby the waters of the Lough and the reaches of the River will be regulated, and in summer, kept up to the levels, fixed for the purposes of navigation.

The lowest level of the waters in Lough Neagh, is proposed to be fixed at 46 feet* above datum, being the level of the summer water in 1826, as ascertained by Mr. Killaly, or about 2 feet below the level in June, 1844. This height is fixed upon as being essential for Drainage combined with Navigation, and that above which the flood waters may rise, for a foot or more, without injury to the adjoining lands.

The water surface of Lough Beg, and the reach below it down to Portna, is proposed to be 4 feet lower than that of Lough Neagh, in order to afford sufficient additional capacity, in time of flood, for the discharge of the waters, without injury to the adjacent lands.

Corresponding arrangements have been made in the lower reaches of the river, down to Coleraine, as may be seen on the section, so as, with the aid of sufficient regulating weirs, and the removal of obstructions, to ensure the same results.

With this brief description of the general design, I proceed to lay before the Commissioners the details of the project, and the reasoning upon which I ground my conviction of success.

In practice it will be found, that in the majority of drainage cases, it is most prudent to commence the execution of the required works at the foot of the falls, and proceed upwards; by this course we "bring our taps with us," and consequently the works in progress can be unwatered with more facility, and at much less cost, considerations in all works of this nature of the first importance.

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* To this level of 46 feet over datum, the sills of the lower locks, and the entrances to the Lagan, Newry, Tyrone, and Ulster Navigations, as also the several piers and landing places on Lough Neagh and Lough Beg, are to be made to conform, so as to have 5 feet on the sills of the locks, at the berths along the piers and landing places, and in the channels leading thereto, at the lowest Summer water.

PROPOSED IMPROVEMENTS IN THE COURSE OF THE LOWER BANN.

In the following recital, I have adopted a similar course of proceeding. I commence my description of the Lower Bann River, at the Cuts or Salmon Leap, near Coleraine, being the lowest fall on the river.

Viewing the proposed measure as one of drainage only, the Cuts or Salmon Leap, as it is called, formed by a dyke of basalt, which here crosses the Lower Bann, holds an important position in connexion with the consideration of this question, being the key to the drainage of a large district of low-lying country, above this barrier.

The natural obstacles which stand in the way of effecting a suitable passage for the flood waters at this place are, as before described, very great, and these difficulties are much increased by artificial obstructions, partly resulting from necessary contrivances, by those who farm the productive salmon fishery at this station, and in some degree by useless encroachments.

To preserve unimpaired the general efficiency of this property, the money value of which is at present considerable, the Engineer is compelled at greatly increased cost, to modify his designs for drainage or navigation, so as to meet as far as it is prudently practicable, the requirements of each interest (drainage, navigation, and fisheries). In this instance we do not, as is in general the case, lessen the cost of the project, by making drainage and navigation a combined measure. The gorge through which the river runs at the Cuts is so confined, and the rock to be excavated is of so obdurate a character, *hard to get*, and from its position, difficult *to dispose of*, that the construction of a lateral canal, which is indispensible for navigation purposes, becomes here a work not easily accomplished, without encroaching on the due limits of the fishing passages, or in other respects interfering with the free discharge of the river, which should neither be allowed to inundate the low lands in winter, nor to have its waters reduced in summer below the level prescribed for navigation.

The difficulties thus adverted to, I propose to overcome by improvements in the river-course, by setting the fishing passages at somewhat a lower level, and by the construction of new works, as hereafter detailed, and shown on the enlarged plan, No. 1.

First.—I propose removing the present fishing cribs, and their separating piers, the agent's house and offices, the old kiln, and as much of the ruins of the old mill, as lie between the wheel case and the river.

Secondly.—To cut down the rock, or as much of it as may be required in the site of the proposed new cuts or fishing passages, and of the regulating weirs, to 8 feet above datum.

Thirdly.—To re-construct the free gap, or Queen's share, in the same site as the present one now occupies, with four new cribs extending from it, towards the western or Derry bank of the river, and accessible from that side by a proper gangway; also, to erect two regulating weirs obliquely posited, and extending from these cribs on each side towards the shore, that on the east side 150 feet in length, and that on the west 350 feet. The level of the coping of those weirs, to be at or near the level of low summer water, so that all or nearly all the water, may then pass through the cribs, and free gap.

Fourth.—To excavate a channel, for the navigation on the east side of the river, as close into the land as practicable, and in it to build a lock for passing the trade from one level to the other.

Fifth.—To remove the island which stands upstream of the Cuts, and a portion of the garden on the west side opposite to it; and excavate the rock in the upper weir basin to a sufficient depth, to allow the water to come forward to the discharging line of the weirs, without obstruction calculated to impede its motion, or raise a head prejudicial to drainage, during the presence of the floods.

It is also intended to form the part of the old mill, which stands on the west side of the wheel case, into a house for the fishing agent, in lieu of that which it is proposed to remove; and that the mill power which is now in existence, may not be lost, but rather improved, new sites are provided at the lower end of the western weir, where a great amount of power can be made available, to the interests of the public, whenever the trade of the country may require it.

The position, and form of the different works, will be better understood, by an inspection of the enlarged plan of this part of the river. (No. 1.)

It is calculated that when the contemplated improvements and new works are completed, the greatest amount of water to be discharged during floods will rarely exceed 400,000 cubic feet per minute, therefore, 500 feet of an effective line of discharging weir, in addition to 110 feet, the space through the Queen's share and cribs, will pass all the surplus water at a level not exceeding 1.75 feet above summer water, or 12.33 above datum, thus, the winter level of the water will stand but about .75 feet above the present summer water at the upper end of this shoal.

From the Cuts to the Loughans, the present channel is of sufficient capacity for all purposes, but at the Loughans, a considerable quantity of excavation in gravel and small boulders will be necessary.

An inspection of the longitudinal section of the river will explain that, it is the intention to carry the bottom of the channel on one uniform level up to Carnroe, a distance of 9 miles, where it is proposed the second lock shall be erected; it is not, however, contemplated to carry one uniform breadth of bottom throughout the entire length of this reach, except that the navigation channel shall, in no instance, be less than 60 feet; but the additional section necessary for containing the flood water within the proposed range, will vary in its form according to circumstances. Where the natural channel is wide, a less depth will suffice; but where the channel is narrow, the depth of the additional section will approach to, or equal, the depth of the sailing channel. It is provided for in this reach, that the floods may rise at Carnroe lock, (the second in the ascent,) 4 feet in height, which will then give a declivity or slope in the surface of the river of something more than 5 inches per statute mile; with this fall, a sectional area of about 2,400 feet at the Loughans, will be necessary to pass the contemplated volume of flood water. The navigation channel to be carried on the west side of the Loughans Island, as it will afford greater accommodation to the trade. A small amount of deepening, by dredging, or otherwise, will be required in various parts of the river upwards to Gill's Ferry, a distance of about one mile and a half. From thence to the Rooghan shoal, a reach of nearly 4 miles, the natural depth is greater than is sought to be obtained for the purposes of this project.

At Agivey, an alteration becomes necessary in the bridge, to afford a facile passage for the craft using the navigation. To effect this, it is proposed to convert the Eastern Ope into a bascule arch. The abutment here will have to be fitted to receive one leaf, and the adjoining row of bearing piles to be aided by two additional rows of similar piles, properly braced, so as to become an abutment to the remaining part of the present structure, and, also, to receive the other leaf of the bascule.

To allow of the necessary deepening along-side the stone abutment without endangering its stability, it is proposed to encase it with a row of guage and sheet piles at five feet distance from its face, and to extend this protection to a sufficient distance on each side of the bridge, to ensure its security. These piles to be well braced and tied with proper wale-pieces, their heads to rise above the level of winter floods, and a towing-path to be formed upon, and behind them, the extreme ends of the range of sheeting piles being turned in a curved line towards, and connected with, the land

The shoals at Rooghan and Drumeil are to be operated upon in the same manner as those above described, namely, by deepening and widening the water-way where required.

At Carnroe, the first reach or level ends; it is therefore proposed to erect here the second lock and weir, to overcome the ascent, which is in summer 6½ feet. The lock to be placed on the Antrim side of the river, a short way below the small island, and the weir extending obliquely from the lock upwards, abutting against the Derry, or western bank of the river. (See enlarged plan, No. 2.) The navigation channel above the lock to be protected by a paved bank extending upwards beyond the immediate influence of the weir. The length of this weir is proposed to be 600 feet, having a free Gap constructed on approved principles, and of magnitude calculated to aid in the discharge of the floods in winter, so as to prevent the water rising more than one foot and a half above the level of the weir capping, and to be otherwise so contrived as not to allow the summer water to fall below the level required for navigation purposes.

The fall in this reach (during floods), which is only about a mile and a-half in length, is 8 inches per statute mile; a sectional area, therefore, of nearly 2,000 feet, will be necessary to pass the flood-water. All the shoals that do not afford sufficient sectional area, or are deficient in depth, are to be cut through or dredged, up to the foot of the Movanagher shoal, where it is proposed the lateral canal for passing those rapids is to commence and be carried on the eastern or Antrim bank of the river to Mr. Moore's lodge, which is at the head of these falls. The project here, is to carry the head-water down, so as to be enabled to place the lock about 500 feet from the lower end of the lateral canal where it enters the navigable part of the river. The canal to be kept as near the river-course as practicable, to save waste of land and severances. The fall in these rapids is so great, that it will require little to be done in the natural channel of the river, except to remove some heaps of stones and gravel to give a more uniform slope to the bottom, which will not interfere prejudicially with the eel weirs.

It is proposed to construct the regulating weir at the top of this fall, abutting at one end on the river-bank of the canal, and extending obliquely upwards for 600 feet in length, to the western bank of the river. To protect trade and other boats using the canal, from being drawn on the weir by the force of the current in floods, (an accident of frequent occurrence, where the entrance to the canal is close upon so great a run of water), it is intended that a rough wall of rubble stone shall be continued upwards from the eastern end of the weir, so as to enclose the conduit of the canal, and remove its entrance to a safe distance from the fall, without encroaching injuriously on the free passage of the great body of the waters. (See enlarged plan, No. 3.)

A portion of the weir basin being rock excavation, will supply rubble stone for the new works in its vicinity.

There are two shoals situated between the Movanagher Rapids and Kilrea Bridge, but they are small and the amount of excavation trifling.

Kilrea Bridge stands upon a shoal, which is to be removed so far as may be required to obtain a sufficient sectional area of water-way; the piers of the bridge underpinned, and a bascule arch to be added at the eastern side of the present structure.

The eastern abutment will require to be underpinned, enlarged, and modified, so as to suit it for the reception of the bascule arch, and both abutments under the level of the impost, are to be faced with ashlar, to correspond with the present piers above the impost; the abutments and pilasters to be of square hammer-dressed stone, with rustic quoins, same as those of the present arches. The impost course, cut-water caps, string courses, and pedestals of pilasters, to be of hewn stone ashlar. The ribs, &c., of the bascule to be cast iron, fixed with malleable iron bolts, ties, &c., the parapet or fence railing, also to be of malleable iron. The carriage way to be timber planked. The retaining walls necessary to support the approach to this arch, will have to be raised and extended, so as to preserve the present inclination of the roadway.

In ascending the river, the next position which demands the construction of new works, and the most important of the whole, is the Portna Falls; here a short side cut becomes necessary, and although each bank of the river furnishes facilities for its execution, the west side has been preferred as possessing superior advantages for the employment of a vast extent of water-power, but not to the entire exclusion of the east side, where several valuable mill sites may be obtained, as hereinafter described.

The difference of level between the proposed summer water, below and above the falls, is 14½ feet, requiring a double lock to pass the trade from one level to the other. It is proposed to construct the lock a short way above the large pool, at the foot of the falls, and to continue the side cut from it along a depression in the surface of the ground, southward of it, so as to enter the river again near the old mill. To allow of the waters to flow freely to the intended mill sites, without creating a current in the canal that would be inconvenient to its navigation, it is proposed to form the channel 50 feet in breadth at bottom, with side slopes of 1½ to 1. An excavation of considerable extent will also have to be made in the rock, gravel and boulder stones forming the shoal at the higher end of the fall, so as to reduce the water in the upper level, and give it a full sectional area for discharge. To provide for the free discharge of floods, a regulating weir, 600 feet in length, (so constructed, as with a given head, to discharge the water supplied from that of Toome,) will have to be erected on a convenient site, near the middle of the present fall, having suitable provision for the passage of the fish. And to remove as far as possible every impediment to the free discharge of the surplus waters, it is proposed that the eel weirs now at the head of the fall, be removed to a site below the intended regulating weir, and as no new passage is to be made for the water by which the fish can escape, the value of the weirs will not, in my opinion, be lessened.

It is also proposed, that the sailing channel shall be on the east side of the river, extending from Mr. Moore's house upwards through the shoal. The rock dips towards this side, and allows of a sufficient navigable depth to be obtained in comparatively favorable cutting; and as the natural channel here is very wide, it will not be necessary to interfere with the rock on the west side to get a sufficient sectional area to pass the flood-water.

At the town of Portglenone, where the next obstruction presents itself, the shoal in the river is to be excavated to the required depth and breadth, both for drainage and navigation purposes. On account of the dilapidated state of the bridge, it has been, as I am informed, in the contemplation of the Counties interested (Derry and Antrim,) to erect a new one on a more favourable and convenient site. In carrying out the proposed measures of drainage or of navigation, it will be a matter of necessity, as well as economy, that a new bridge be constructed here, suitable for the discharge of the waters, the present bridge being composed of such bad materials and such indifferent workmanship, and being in so unsafe a condition, that its total demolition must be the consequence of any attempt to remove the shoal on which it stands, or the obstructions to the stream of the river, by which it is at present protected. It is, therefore, proposed to erect a new bridge, on improved principles, and with substantial materials, affording ample freedom for the passage of the water at all times, and security and convenience to the public frequenting this important thoroughfare.

The bascule arch necessary for the accommodation of the navigation, it is proposed to erect on the eastern or Antrim side.

The enlarged channel is to be carried through the upper shoal on the principles already explained.

At the new ferry a sufficient depth of water will remain for navigation purposes on the west side of the river, yet, as there is a shoal on the east side which after the proposed regulation of the water level, will not afford the enlarged sectional area of channel required for the discharge of the floods, without injuriously raising the surface of Lough Beg, it becomes necessary that the impediment it presents, as here observed upon, shall be removed.

The next obstruction met with in our ascent is the shoal at the entrance into Lough Beg. It is proposed to deepen and improve the present sailing channel through this shoal, and although it is rather tortuous, there are sufficient indications to show that the safest course to follow will be that in which the water now flows in greatest depth; less excavation will be required, and there will be greater certainty of the enlarged channel continuing clear of deposit.

It is proposed, as essential for the measure of Drainage, that the level of the summer water be fixed at 42 feet above datum, being 6 feet below the surface level of Lough Neagh in June, 1844.

When Portna and Portglenone are cut down, or even when partially removed, for the purpose of facilitating the execution of the proposed works, it is fair to infer that the current will be so great through Lough Beg that with some assistance from what is technically termed "hushing," the soft mud of which its bottom is composed, will be carried off to the required depth at comparatively little expense, and deposited in the deep hollows in the bed of the river, between the Lough and Portna. The width of the sailing channel through the shoal, will correspond as to dimensions, with that proposed for the river below, especially as it can be distinctly marked; but through the Lough, a channel not less than 200 feet uniform breadth of bottom will be requisite, and the course marked throughout by beacons and buoys.

The shoal at the upper end of Lough Beg is rather of a different character from those described, being entirely drift sand, easy of removal. In the sailing course, it will be necessary to pass on the east, or Drumraymond side of the rocks, as the channel. if made on the west side, would extend too far into the valuable meadow land of the Creagh Island, and by keeping it on the east side, the excavated material can be placed over the shoals in Cammbay, which will raise and form them sufficiently high for cultivation. It is proposed to carry up a channel of 120 feet uniform breadth of bottom, from Lough Beg to within a short distance of Toome Bridge. To prevent a diversion in the stream during floods, and the formation of new banks and shoals here, it is proposed also to fill up the entrance into the old channel of the river, so as to turn the stream altogether into the new cut from this downwards, and so avoid the hard shoal at Brecart cottage, and partially to straighten the river-course. It is prudent to keep to the west side of the natural channel at the eel weirs, trimming off the west bank, and passing through the point to enter the river a short way above the farm cottages, which are proposed to be removed and rebuilt on a new site a little landward of their present position; the spoil from this may be laid on the Brecart side, by which the low sandy bay will be raised and made fit for agricultural purposes. The Goose Island will have to be removed, and the spoil made use of to fill up the low broken ground on the western side of the river.

Toome bridge will require great additional depth to its piers and abutments, to adapt it to the intended river channel; it is therefore proposed to underset them about 16 feet on an average, and to remove all surplus material from its Abutments, Piers, and Sterlings, and the immense heaps of rubble stone by which they are at present defended, so as to give a clear water-way down to the bottom of the proposed channel, for the full breadth between the shafts of the piers. The facilities required for navigation purposes must be provided for here, same as at the lower bridges on the river; it is therefore proposed, that a bascule arch be constructed at the back of the eastern abutment, and suitable retaining walls built, extending to such a distance as will allow of the approach at that end of the bridge, which is at present inconveniently steep, to be improved.

The small harbour made some years back, by Lord O'Neill, at the village of Toome, and now nearly silted up, is to be enlarged, so as to accommodate trade boats at the side next the village. The recedence of the harbour from the line of shore to be the same as originally laid out, so as not to interfere with the adjoining garden.

From Toome bridge upwards, the sailing channel is gradually detached from the river course, as the bottom of the former continues level, and that of the latter here commences to ascend; at the watch-house of the upper eel weir it becomes separated altogether by an embankment, and continues close to the shore until it reaches the site of the intended lock which is to be placed at the angle, where the division between the Lough and present river-course becomes distinctly visible.

The ascent to be overcome by this lock is 4 feet. The sailing channel of this reach is to be continued in the same straight direction, and the upper or summit level carried out, until sufficiently deep water in the Lough is attained. To afford protection and security to the trade, it is proposed to run a mole of rough stones along the western side of the channel, from the lock to a distance of about 400 yards. (See enlarged plan, No. 5.)

It has been stated that the bottom of the river channel commences to rise at Toome bridge. This inclination is to be continued up to the toe of the regulating weir, where it is proposed that the level of the bottom shall be 38.00 feet above datum, and 8.00 feet below the intended summer level of the Lough; the breadth of the channel to be equal to the distance from abutment to abutment of Toome bridge, until it enters the expansion for the weir basin with which it is to conform.

The regulating weir at the entrance into Lough

Neagh, as shown on the diagram Plan, (No. 5,) is to form four sides of a regular polygon, the radius of whose circumscribing circle is 700 feet. The sides are 300 feet long each, making a total length of 1,200 feet of weir; 300 feet in the centre of which is intended to be horizontal, the Flanks sloping upwards within fixed limits; from thence to the extreme ends, so that the line of discharge becomes extended as the water in the Lough rises.*

It here becomes necessary I should satisfy the Commissioners, that the means proposed for passing off the whole of the flood waters of Lough Neagh, under a maximum head of 12 inches, (above summer level,) are fully equal to the objects professed, or required.

From the documents previously referred to in this paper, and from other authentic sources, it appears that the average rise of floods in the lake at present, is one inch per day, and that a great portion of this rise, may fairly be attributed to the obstructions raised by the bar at Toome, and by the inadequacy of the channel of the Lower Bann; therefore all that is wanted to keep the surface of the Lough at a uniform level, or at all events within the limits of an ascertained small range, is to make provision for the free discharge, within the space of 24 hours, of a greater quantity of water than the cubic contents of one inch in depth, over the entire surface of the Lough, would produce, under a head less in height than the proposed range in the level of the Lough's surface, and if such provision be made, it needs little argument to prove that the water surface in the Lough, cannot be materially elevated.

The registries, however, show that a rise of 4½ inches in 24 hours has taken place, and that in five successive days the waters have risen 14 inches. It is clear that provision must be made to prevent the sudden influx of so large a body of water, as would be thus produced, being attended with injurious consequences.

We have already stated, that the summer discharge from Lough Neagh, in round numbers, is 100,000, cubic feet per minute, and it will be seen on reference to the plans, that it is intended to place the apex of the centre part of the proposed regulating weir at Toome, 12 inches below the summer surface of the Lough. Allowing then for a rise of 4½ inches by floods, on this surface there will be 16½ inches in depth of water, flowing over the weir, which will increase the discharge to 160,000, cubic feet per minute. And when from a long continuance of rain, and consequent accumulation of flood water, the rise over the summer surface, amounts to 12 inches, the discharge will be increased to nearly 400,000, cubic feet per minute.

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* With reference to the Fisheries of Toome, *see* page 67.

On the case here instanced occurring, the length of the discharging line will, from the form of the weir, gradually increase with the height of the floods, therefore if the average surplus above the summer discharge be taken, it will be found that during the five days of the rise observed upon, a quantity equal to two inches in depth, on the whole surface of the Lough, will have passed away, so that the actual elevation will only be 12 inches, and not 14 as stated. The maximum discharge has therefore been taken at that due to 12 inches, over the proposed summer level.

One inch in depth of water over the surface of Lough Neagh, is equal to 356,593,050 cubic feet; to discharge this quantity in 24 hours, 247,638 cubic feet per minute, in addition to the summer discharge of 100,000 cubic feet, must pass over the regulating weir at Toome; these together make 347,638 cubic feet. But should the rise occasionally exceed by a few inches, (which is all that can occur,) the contemplated range of the level, so as to increase the discharge even to 500,000, cubic feet per minute, no damage can accrue to the works, or injury to the lands, as the elevation will be effectually controlled by the extraordinary compensating power of Lough Neagh and Lough Beg as reservoirs, enabling means to be adopted, by which the influx and efflux of the flood water will be so balanced, that the rise can never overflow, nor can the capacity of the improved channel of the Lower Bann be overpowered by a greater body of water being thrown into it, than it can, without prejudice to the land on its banks, or to the navigations connected with it, discharge.

The sectional area of this channel, the several dimensions of which have been already given, has been fixed from accurate calculations, based on the unerring data of the quantity of water discharged under a given head, within a limited time. These dimensions, I am confident, will in every way be found suitable, and the result will be, the quiet conveyance to the sea of the whole of the surplus waters of this immense district, without injury to its low marginal lands, or interruption to its traffic; thus proving that the antagonism heretofore said to exist between the systems of drainage and navigation, has no reality. On the contrary, as this report and the appended estimates testify, *by combination they mutually assist each other, both as to effectiveness and cost.*

PROPOSED IMPROVEMENTS IN THE COURSE OF THE UPPER BANN RIVER.

As a consequence of the measure of improvement proposed to be effected at Toome Bar, and on the Lower Bann River, the remedies necessary to be applied here, become simple and easily accomplished. It has been ascertained that the fall in summer, from the point where the Newry Canal enters this river, to Lough Neagh, is only ·07 of a foot, and during winter floods, the fall in the same reach is only ·50 of a foot, of which, ·30 occurs between the entrance of the canal and Portadown bridge. It is not, therefore, too much to say that, when the level of the surface of Lough Neagh is lowered to the standard above given, the stream of the Upper Bann River will at all times run within the limits of its natural banks without the aid of artificial mounds.

Between Portadown and Knockbridge, some shoals occur which are to be excavated, so that a navigable depth of water may be preserved home to the entrance into the canal. (See Longitudinal Section.)

The low meadows near Knockbridge stand at a height of 50 feet above datum, and the proposed level of winter water in the Lough, as before stated, at 47 feet. A fall, therefore, of 3 feet will be obtained for the drainage of this tract, being six times greater than the cultivators have ever had, or can at present command. The flood water at Knock is just lipping with the low part of these meadows, and in consequence, the grasses are coarse, and tillage is never attempted.

With a view of giving greater facility to the discharge of the floods of the Upper Bann, it has been proposed to shorten the course of the river by giving it a new direction.

For this purpose two lines were laid out; one from a favorable bend in the course of the stream at Slantry, about three miles below Portadown, to enter the Lough at its nearest accessible point, *Derryadd Bay*, and so shorten the length about four miles; the other to depart from the river somewhat lower down, to pass through Lough Gullion, and the high ridge separating it from the lake into which it was to enter, in Trowagh bay; this line would shorten the river-course about 2½ miles.

The excavation in either line is nearly alike; but that which passes through Lough Gullion could be made the means of extending reclamation to nearly 200 acres of land easily made profitable, the value of which would in part compensate for the cost of the work, a benefit the Derryadd line has not the means of conferring; whilst, on the other hand, the Derryadd line enters a suitable harbour, which is not the case with that of Lough Gullion.

Consideration is, however, also to be given in comparing the advantages of those propositions to a third mode for facilitating the free passage of the river waters into Lough Neagh, that is the dredging of the bar at Bann Foot. The materials of which this barrier is composed, are easily excavated, the expense, therefore, would be light *in comparison with either of the other measures;* and as the object is to remove the obstacles standing in the way of drainage and navigation, the lowering of the bar will effect all that is required in this way, when the waters of the lake are reduced in height, and preserved at a uniformly low level, which may be further insured by the construction of a suitable mole, of a curved shape, extending into the deep water of the Lake. Consequent on this reduction, the fall in the river will be increased, and the lands on its margins permanently freed from injurious floodings.

PROPOSED IMPROVEMENTS ON THE RIVER BLACKWATER; WITH SOME OBSERVATIONS ON ITS CIRCUMSTANCES.

The River Blackwater, from the length of its course and the great extent of its catchment basin, is the most important of all the tributaries to Lough Neagh.

Its geographical position with respect to the Lough, and the physical formation of its surface, tend greatly to accelerate the speedy passage of the rain water it receives, into the basin of Lough Neagh; hence a volume of water, equal to 500,000 cubic feet per minute, is found passing in time of floods, down the valley in which the Blackwater runs, while the maximum discharge from the Lough at Toome Bridge, remains unchanged in its action during floods, rarely exceeding 400,000 cubic feet per minute, notwithstanding that it has the water of 1,248 square miles of country to accommodate, in addition to the great amount of the contribution from the basin of the Blackwater.

These facts are strongly illustrative of the great advantages conferred on this district by the extent and position of Lough Neagh. Placed by nature as a point of convergance to several powerful and turbulent rivers and streams, it receives and calms the impetuosity of their waters, rendering them fit for man's use, and almost without a parallel as to value amongst his industrial resources.

The evidence of these facts goes to show, that the compensating power of Lough Neagh as a receiving basin is fully commensurate with what we have already stated respecting it. I, in this instance, select an extreme case, that of the Blackwater sending into its recipient (Lough Neagh) so enormous a quantity as 500,000 cubic feet of water per minute, equal to 720 millions in 24 hours. Notwithstanding this great mass, collected off a basin having an area of 618 square miles, it would require a similar abundant supply for nearly three successive days to raise the Lough's surface to 4½ inches over its summer level, therefore, when the obstructions in the Lower Bann river are removed, and the works proposed for rendering it a sufficient drainage conduit, with those hereinafter proposed for the tributaries, effected, we may with confidence reckon that those whose praiseworthy zeal for ameliorating the condition of the poor, by improving the healthiness of the country in which circumstances compel them to live, and the fruitfulness of the soil they cultivate, by an effective system of drainage, will find their most sanguine hopes fully realized by the success, certain to attend their efforts.

The works referred to for the improvement of this (Blackwater) River, are the repairs, and, in part, reconstruction of the embankments and self-acting sluices, or cloughs, above Charlemont Bridge; and the same system, but on a better principle, to be carried downwards as far as Verner's Bridge, and up the River Callan, to Callan Bridge, the Tall to Tall Bridge, and on the Blackwater to the first lock on the Ulster Canal.

To dredge or excavate all the existing shoals to the depth marked on the longitudinal section; to improve and straighten the river-course, (as shown upon the detail plans in this office,) where practicable, and to get rid of several sharp turns, by new courses, especially near the entrance to the Ulster Canal; to remove the flood-gates on the Tall; to dredge the Bar at the Blackwater foot, and to deepen the Maghery Canal.

The new embankments for confining the floods within reasonable limits, are, as stated, to be extended from Charlemont to Verner's Bridge, and formed on top with a declination of 9 inches in a mile.

The foundations of the abutments to Verner's Bridge are to be secured by sheet piling, wales, and braces, same as specified for Agivey Bridge.

To take down the old bridge at Charlemont; to remove the shoal on which the structure now stands, and to build a new bridge, on better principles, and with suitable materials in its stead.

By the works and improvements here proposed, a channel of ample sectional area, will be obtained for conveying the floods of the Blackwater to Lough Neagh, without spreading over the adjoining low land.

The fall in the river, from Charlemont Bridge to Lough Neagh, a distance of nearly 12 miles, is, in summer, rather under two inches, and during the winter floods, about three feet, say three inches per mile; but by the proposed system of embanking and dredging, a fall of nine inches per mile will be obtained in a channel having a mean hydraulic depth of 12 feet, and a sectional area of 2,164 feet.

The proposed embankments on the Callan and Tall will, when the waters are lowered in the Lake, effect all that is necessary for their improvement.

The River Torrent has in itself ample fall, and when relieved from the present injurious influence of the Lough Neagh floods, a trifling clearing made in its channel, by the removal of some shoals of inconsiderable extent, between the Main River (the Blackwater) and the first lock on the Coal Island Canal, the lower sill of which is to be taken up and placed at a lower level, so as to secure the same depth of water on it in summer, when the Lake is lowered, as it now possesses,) all that is required for its improvement will be accomplished

PROPOSED IMPROVEMENTS ON THE RIVER MOYOLA.

The Moyola River, although running in its mountain course, during floods, with great violence, does not by its waters injure much land comparatively, within the limits of the drainage district; and when the regulation of the waters of Lough Neagh, and the fixing its surface near the present summer level is carried into effect, it will greatly benefit the portion now subject to periodical inundation.

The principal improvement within our means, is to remove the timber and stone work placed for protecting the foundation of the new bridge (so called), to cut the bearing piles on which the abutments and piers rest, at the required level for the bottom of the drainage channel, to lay on a new platform for so much as will be removed, and to underset the masonry from the surface of the new platform up to the present work.

The course of the river, from its crookedness, offering great resistance to the free passage of the stream, it is proposed, just above the bridge, to straighten it by cutting off the sharp angles and removing other obstructions, so as to admit the current to approach the water way of the bridge more directly, and to allow of the flood waters passing to the Lough without injuriously affecting the lands above it.

PROPOSED IMPROVEMENTS ON THE RIVER MAINE.

The bar at the Maine water foot was dredged a few years back, and the channel made navigable, also some wharfs constructed for public accommodation by Lord O'Neill. In the measure now brought forward it is proposed to preserve the navigable channel and wharfs in every respect, in a state fully equivalent as to public accommodation, to that which they now afford.

PROPOSED IMPROVEMENTS ON PORTMORE LOUGH.

The area of this Lough is somewhat above 600 statute acres; around which there is a large belt of flooded land, in a great degree unproductive.

When the waters of Lough Neagh shall be fixed at their summer level (as proposed), the injured lands on the margin of Portmore Lough, will be in a position to be relieved at a trifling expense by the mere clearing up of the existing drains and water-courses. The lowering of the waters in Lough Portmore, is necessarily dependent on the level of Lough Neagh, which being fixed at its permanent low standard, Lough Portmore will have its surface lowered in the same ratio, the depth of water over whose uniform bed on the 10th June, 1844, may be taken at an average of 4 feet, leaving its bottom but 44 feet above datum; and as it is proposed to fix the summer surface of Lough Neagh at 46 feet over datum, when this is effected there will be but 2 feet of water impounded within the hollow of Lough Portmore; this small quantity it will be by no means a difficult task to expel, and its extent when rendered fit for cultivation, holds out to the enterprising speculator, a fair prospect of a remunerative return.

I do not consider the failure in an attempt of a similar nature, here and in another part of this district, a reason why an effort should not again be made under altered circumstances, the attempt alluded to, having been made under a series of disadvantages, which will not properly belong to Lough Portmore or

Lough Gullion, when the waters of Lough Neagh are lowered.

In carrying out the mere Drainage measure, we confine ourselves to what has been already recommended, namely, the clearing up of the water-courses and drains; but if the reclamation of the Lough were decided upon, it would be necessary to direct the course of the Portmore River, and the Ballinderry mill-stream, from a point a short way above Portmore Bridge, northward in a contour channel strongly embanked, towards the Lough, and a few yards, for the most part, clear of the limit of the present highest winter floods. This channel to receive in that direction all the minor streams which now flow into the Lough, and after passing Ogles, to turn towards the westward, to form a junction with the Crew Burn, keeping along the base of the upland to Tunny Bridge. By this means the Lough will be completely severed from its rain basin on the east and north; and to complete the severance, it is further proposed to cut a large drain, commencing about half a mile to the south of Portmore Bridge, bearing to the westward, in order to receive all the small drains, and the Aghalee stream to terminate in the Selshan drain, which must be enlarged and improved into Selshan Harbour. This main drain or channel will receive all the minor drains and streams on the south, and will fully complete by contour lines, the insulation of the Lough. When it has been thus detached from its rain basin, it will be subject to the influence of no water but what falls within its own circumference, or what may be produced by springs, so that the drying of its bed will be made comparatively easy. To effect this very desirable object, it is proposed to make use of the accumulated waters referred to on the north side, to generate a power at Tunny Bridge, to lift the water out of the Lough by a scoop-wheel. It is presumed that when the precautionary measures before enumerated have been effected, the quantity of water to be discharged by the scoop-wheel will be small, and therefore, a few hours' work each day will suffice.

That all the advantage possible, may be gained by the power so generated, it is within the means of the projector to erect in connexion with this scoop-wheel a corn-mill, which may be usefully employed in preparing the produce of the neighbourhood for market; and by a simple arrangement, the scoop-wheel and corn-mill, can be alternately engaged with, and disengaged from, the prime moving water-wheel, as circumstances may require. This adaptation will not only cover the general cost of the scoop-wheel, but will prove a source of profit to the proprietor, and a great accommodation to the public.

These simple means, the principles of which are here briefly explained, may be usefully employed in the reclamation of this large tract of valuable land; and its cultivation within certain limits as to classes of produce, from the perfect mode of irrigation which will be at all fit times available, is, I would think, a sufficient guarantee for its productiveness.

PROPOSED WORKS FOR THE FISHERIES IN THE DISTRICT.

In effecting the Works for the improvement of this district, full consideration has been given under the direction of the Commissioners, who are also Commissioners of Fisheries, to the protection, preservation, and improvement of the important Salmon and Eel Fisheries of Lough Neagh and its rivers.

I have described in detail the Works proposed to be executed at Coleraine, not only for maintaining, but, as I am informed by those practically acquainted with the subject, improving the means of fishing for both salmon and eels at that important station.

In addition, I have only to observe, that in each of the proposed regulating weirs, suitable facile passages for the migration up and down of salmon, trout, eels, and other fish, and the fry of eels, will, in accordance with the provisions of the Fishery Act, 5 and 6 Vic.,

c. 106, sec. 63, be constructed and maintained under the surveillance of the Board; and from all the information I have obtained on this subject, I confidently anticipate that the facilities thus given for migration at the proper seasons, combined with the protection which the uniform deep reaches of the river when improved will afford, must materially increase the stock of fish in the district.

In referring to the means to be adopted for taking eels near the present sites of these fisheries, I have already described those to be used at Moyvanagher and Portna; moreover, in every other instance, it is proposed that eel-weirs of a suitable construction, shall be placed below the regulating weirs, opposite the migration passes referred to, so as to take the eels on their descent to the sea; and these weirs, being placed out of the navigable channel, will in nowise interfere with navigation, whilst their construction and position will prevent their having any injurious effect upon the discharge of water.

At Toome, similar arrangements are to be made, as may be seen upon the detail plan (No. 5), where it will be perceived that the new eel weirs are proposed to be placed below the great regulating weir, and between it and the entrance of the navigable channel, from the lock into the river-course. These weirs are proposed to be constructed on the best principles, with a double row of piles, and suitable gear for attaching the nets, whilst a substantial gangway may be made across them, and thus the greatest facility afforded for fishing there at the proper seasons; and a fish-house may also be conveniently placed on either bank, at the extremity of the weirs, for the convenience of the fishermen.

It is also right to add, that during the construction of the Works, such arrangements can be adopted as will not only suit the free migration of the fish, but their capture also by the parties entitled, so that even in this respect no loss is anticipated to result.

FIFTH.

THE ESTIMATED COST OF THE MEASURES FOR DRAINAGE AND NAVIGATION.

In preparing the estimates for the several Works enumerated in the foregoing Report, I have been governed by the strictest rules of economy, so far as a due consideration for the permanent execution of the Works permitted; recollecting at the same time, that the increase in the wages of labour, owing to the certainty of increased employment, requires from those called upon to value the cost of executing works in Ireland, in order to avoid future disappointments, to frame their estimates so that the amount may fully cover the expense of the undertaking.

In the designs, I have endeavoured, by a simplification of the principles upon which the works are to be constructed, to lessen the cost in every practicable way, without prejudice to their fitness and stability. I have kept in view, and have acted upon the provident instructions of the Lords of Her Majesty's Treasury to the Shannon Commissioners, by which the country has profited much, namely, "that whilst nothing is omitted that is requisite for "the substantial and permanent character of the "works, that the whole should be executed in the "most plain and economical manner, all extra expense "for decoration and ornament being rejected, *as the* "*magnitude and importance of the work will in fact be* "*its most appropriate ornament.*"

The following is an abstract of the cost of the whole work, and the expenses attendant on its fiscal management.

ABSTRACT.

Discharging Channel, the Lower Bann River.

	£	s.	d.
For Drainage and Navigation, including changing sites of, and improving fisheries, .	124,747	13	3
Improvements on shores of Lough Neagh, by lowering Lock Sills and deepening entrances to the Canals, deepening the Main Waterfoot, and the Six-mile Waterfoot, and underpinning their Wharfs; also underpinning the Piers on the Lough, ...	4,535	0	0
Improvements in the following Tributaries to Lough Neagh—The Blackwater Navigation, and the Callan Tall and Torrent Rivers; the Upper Bann Navigation, &c.; the Cusher River, and the Moyola River, . . .	24,003	0	0
Bridges—Portglenone, Charlemont, and Blackwater—the expenses chargeable to the Counties, ...	10,200	0	0
	£163,485	13	3
Preliminary expenses—Survey, Plans, and Valuation, ...	2,000	0	0
	£165,485	13	3
Contingencies and superintendence, including consequential damages, ...	16,548	11	4
	£182,034	4	7

The Works of the Lough Neagh Drainage and Navigation, enumerated in the foregoing estimate, will require 3 years to execute, taking the money to be borrowed at 4 per cent., and the calls as under:—

	£			
First year—£50,000, Interest for 3 years, at 4 per cent., equal .	6,000			
Second year—£60,000 for 2 years, at 4 per cent., equal . . .	4,800			
Third year—£72,000 for 1 year at 4 per cent., equal . . .	2,880	13,680	0	0
		£195,714	4	7

NOTE.—The details of the above will be found in Appendix—Estimate No. 1.

No. 2 in the Appendix, is a comparative estimate of the cost of the works from Lough Neagh to Coleraine, considered under the following heads, viz. :—

Drainage alone,
Navigation irrespective of Drainage,
Drainage and Navigation combined.

No. 3 is an estimate of the cost of the Drainage of the whole district (inclusive of tributaries), with a measure of Navigation combined, from Lough Neagh to Kilrea; the latter including the side cut for passing the rapids at Portna, by which the portion of the water power of the Lower Bann generated here is concentrated at the foot of the falls, and there becomes available.

SIXTH.

THE BENEFITS ANTICIPATED TO RESULT FROM THE PROPOSED MEASURES.

The result of carrying out this great measure of improvement to the full extent herein proposed, will be to benefit a very large portion of the North of Ireland.

First, by the drainage of the lands and the consequent improvement in the sanitary condition of the country.

Second, by the extension of internal navigation.

Third, by the increase of water power for manufacturing purposes.

I have so frequently referred to the first of these subjects throughout this Report, that further comment does not here appear to be necessary.

With reference to the second—"Internal Navigation"—I now beg to offer the following observations. Those who feel desirous to advance the prosperity of this locality, and who, in their endeavours, seek to take advantage of the favourable circumstances connected with the Lower Bann River, for purposes of navigation, will, I should hope, on giving the subject the consideration due to its great importance, perceive that although the converting of this river into a navigation, *irrespective of drainage*, is quite within the means of ordinary skill to accomplish, its success as such, would be so pregnant with evil consequences to the population, in perpetuating the misery which a noxious atmosphere now inflicts upon them, and in precluding them (I may say permanently), from bringing within the limits of cultivation, large tracts of *submerged lands;* the source of the many evils they are now suffering from, no prospect of gain to be obtained under such circumstances, should, in my opinion, induce capitalists with the facts before them, to support a measure that would be the means of preventing the perfect drainage, and consequent cultivation of 25,000 acres of land, now rendered comparatively unproductive by the floods of Lough Neagh, and the rivers connected with it.

The very large discharging channel required for the drainage of this vast district, affords the opportunity of *combining with it*, a system of inland navigation, suited in all respects to the present and prospective trade of the country.

To the consideration of the principles this system involves, I have given my best attention; and hope the measures recommended, may be found to meet practically all the objects of those interested.

On referring to the extracts given in the foregoing part of this paper, from the Reports of those engineers who have examined into the merits of this great project, it will be seen that their views differ so importantly both on engineering principles, and on the scale of the works, that they do not aid a succeeding inquirer, to the extent the scientific labours of such men should do. One important item—the quantity of land flooded—I have ascertained to be nearly double what had been heretofore calculated on; and I cannot perceive in these Reports, that the extent of the Catchment Basin, having an area of 1,179,520 acres, has been at all referred to, in treating of the intended improvements, although its surplus waters intimately affect the condition of the Lower Bann, and therefore mainly influence the scope of the remedial measures to be adopted.

With a full knowledge of the facts before me, I have endeavoured to render my designs, and the scale of the works I propose, commensurate with the magnitude of the undertaking, and the commercial interests of the country.

The Lower Bann, the draining conduit in which the navigation is intended to be carried for its whole length, 37 miles, affords ample breadth and depth of water, for a most useful class of screw-propelled steam boats with power capable to stem the currents of the river, the violence of the Lough Neagh gales, and the tides of the Bann estuary. Such boats as tugs, will also greatly aid the Cross Channel trade with Coleraine, and with the interior of the country, when a channel for connecting the navigation with the river below the bridge shall be completed.*

The dimensions of the lateral canals,† designed to carry the navigation past the rapids are as follows:—36 feet wide at bottom,‡ 60 feet at summer water surface, having then 8 feet water on the cills. The banks throughout to be carried 2 feet above the highest winter floods.

The locks are to be 130 feet in length from cove to cove, 20 feet 6 inches in breadth between the quoins, and the coping of the chamber and forebay, set at 6 inches over the top of the highest flood. A bascule or lifting bridge to be placed in all the road bridges crossing the river, to facilitate the passage of sea-going vessels of suitable draught of water, to and from Lough Neagh.

The scale of dimensions here given, I have chosen for the security and convenience of the trade using the river. As, where supplies of water are abundant, which is the case on the Lower Bann, a lock of large size is in no other way objectionable than in the cost of original construction, and a very small amount for increased maintenance; and as the whole of the excavation in the lateral cuts, with the exception of that at Portna, is required for the embankments, there is little increase of charge to be calculated on under this head; and when the comparative expense of large and small canals is gone into, and set opposite the advantages arising from increased capacity in locks and canals, circumstanced as those on the Lower Bann Navigation are, connecting an "inland sea" with an arm of the Northern Ocean, the utter unsuitableness of a canal, of the limited dimensions in use in parts of this district, (such as the Ulster Canal) for performing the functions required of a navigation from Coleraine to Lough Neagh, needs no explanation.

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* A cut of about 200 yards in length, crossed by a Bascule Bridge, is all that is required to effect this connexion.

† The falls are already given, and their sites described—See Works of Improvement on Lower Bann River.

‡ Except at Portna, where the bottom is to be 50 feet wide.

The country through which this navigation is carried is populous, its trade thriving, and its land productive. There are several rising towns on its banks and contiguous to its course, and the terminus, the town of Coleraine, is prosperous and public spirited—witness its harbour at Portrush.

According to the Railway Commissioners' Report in 1838, the gross value of the exports and imports of Coleraine was £180,000. In the year ending November, 1844, according to a traffic statement sent to the Provincial Bank in London, (with a copy of which I have been favored) the exports were £230,000, and the imports, say £220,000, gross, £450,000, being £270,000, over the declared value in 1838;* and this improvement has arisen without any enlargement by roads or otherwise, of its productive basin, or additional facilities being afforded to its trade by cheapening the cost of transit.

The reader can at once see by reference to the diagram map, that the outline of the rain-basin of the Lower Bann, is a clear indication of the limits to which the produce basin of Coleraine can at present be extended by land; these limits contain an area of 340 square miles, within which, by the Census tables of 1841, there is a population of 90,000 persons, and an extent of arable land equal to 136,232 acres.

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* See Appendix No. 4.

Coleraine is the natural port through which the commerce of this district is conducted. The ridges which bound its rain-basin, mark out the very circumscribed extent to which, in its present state, internal trade can be carried on.

If then, as is herein proposed, the waters of Lough Neagh be united to the port of Coleraine by a commodious navigation, the enterprising Coleraine merchants will have opened to them the markets of a large share of the produce of those districts impinging on the Lough, which are now, from the geological configuration of the country, quite beyond their reach.

As a valuable auxiliary to the information already herein given, I beg to refer the reader to the Appendix, No. 9, in which will be found a brief memoir of the geological products of the shores of the Lough, and of the adjoining districts which are more immediately of economic or industrial value, and, therefore, more intimately connected with the trade and commerce of the country; for this very interesting paper, I am indebted to my friend, Professor Oldham, whose intimate knowledge of this particular locality, renders his observations much more useful than any I could offer on the same subject.

Amongst the results to be expected from the execution of the works and the regulation of the waters of Lough Neagh and its tributaries, will be very important benefits to the Navigation of the Lough and the canals and river-courses connected therewith.

The regulation of the waters by freeing the low lands from floods, will make the sailing courses of the Upper Bann and Blackwater at all times distinguishable, even in dark nights, whilst at present the navigator is, during a great portion of the winter, bewildered, in the midst of wide spread floods, to discover his course. The removal of the shoals, bars, and rapids, will confer another important advantage on these navigations, and enable vessels, deeply laden, at all times to navigate these waters, even in the driest Summers; whilst the adjustment of the lower sills of the several locks on the canals entering this Lough, so as to afford 5 feet of water over them, in the *lowest state* of the waters, will remove all uncertainty, and enable these canals, whenever their Summer supplies are rendered sufficient, to improve their navigation to the utmost extent.

With reference to the shores of the Lough itself, and any piers and harbours around it, the very small variation in the level of the waters which will in future take place, affords the greatest facilities for the improvement and extension of these works, and the construction of others; and much saving in expense (as is well known to practical men) may be effected when not compelled to provide by the increased height of such works for the great variation in level which now takes place.

The Admiralty Chart of the Lough shows that at the proposed level of the waters, there will be ample depth in every important place for the commodious navigation of the Lough; and the very few shoals that do exist may then be properly marked by buoys, or beacons, or have channels cut through them where necessary, so that the sailing courses will become known to all without that liability to change which the present variation of the water levels leads to.

WATER POWER OF THE LOWER BANN.

In reference to "manufacturing power"—Sir John Leslie remarks that "water is the readiest and most powerful agent that can be directed by human skill." It therefore adds greatly to the value of the internal resources of a country, to have this great power abundantly supplied, and widely distributed; and these advantages are still further increased, if by the peculiar physical features of the locality, the surplus waters can be detained at high levels, and collected into natural reservoirs, from whence their concentrated power may be profitably meted out by art, and thus allowed to dispense their beneficial influence over extensive tracts of country, in their descending progress to the sea.

Here, Providence has performed in the most perfect and ample manner, what would otherwise require from man much skill to direct, and such an immense amount of labour and expense to execute, as would in a great measure neutralize its benefits. All that is required in this district, is to aid nature by the removal of the existing impediments which check the free discharge of the waters through the Lower Bann, and skilfully to direct her energies so as to generate mechanical power, at the points most suited to the location of manufacturing establishments.

The foregoing remarks have immediate reference to the Lough and to the Lower Bann River alone, as the mill-power of the tributaries to this great reservoir are not taken into account; the district as limited by the Commission, not extending beyond the lands influenced by the waters of Lough Neagh itself.

The following observations on the extent and effects of this water-power, apply therefore only to the Lower Bann.

It has been already stated, that the average discharge from Lough Neagh during Summer, is 100,000 cubic feet per minute, and that in winter it is something under 400,000 cubic feet.

This vast motive power, the bountiful gift of nature, is here offered on a scale of unequalled greatness, to those whose enterprising spirit may promote and bring to maturity, this truly national and beneficent measure.

A feature of great interest in the natural formation of the Lower Bann, and one of great value in the proposed measures of improvement, is the distribution of the falls of the river, into four distinct and convenient divisions, each easy of access; that is Portna, near Kilrea, Movanagher, Carnroe, and the Salmon-leap, near Coleraine. In addition to the power concentrated at these points, a fluctuating power of some extent may be obtained at Toome Bar, but it is not taken credit for in the estimate.

The first and principal fall, therefore, (omitting that at Toome Bar) is at Portna, amounting to 14½ feet. The effective fall for mill-power is taken at 13 feet; but as I am not called upon by the Board's instructions to offer any engineering opinion, as to the best or most productive mode of applying the whole of the hitherto latent power generated in the great basin of Lough Neagh, I leave the investigation of that portion of the subject to the parties who may hereafter require to use it, and for the security of those *now interested*, I have had our calculations based on the minimum amount of power we shall at all times derive from the summer discharge of the Lough, namely, 100,000 cubic feet per minute. This constant quantity will create a power equal to 189 horses per foot of fall; estimating the Dynamic unit at 33,000, the whole power obtained at the Portna fall will therefore be 2,457 horses, equal to the work of 24 manufactories, requiring each the power of 102 horses, for 24 *hours per day*. Should, however, the time for working in factories be limited to 12 hours per day, it may be a desirable object to preserve the water that would otherwise run to waste during the night, or when work was suspended.

The discharge from Lough Neagh during the 12 hours of night, or by the suspension of work as assumed in the factories, will amount to 72,000,000 cubic feet, and would raise the surface of Lough Beg and the River as above referred to, 6 inches.* It follows, that if a simple moveable contrivance were adopted for adding 6 inches to the height of the regulating weir at Portna, *when required,* all the water, amounting to 72,000,000 of cubic feet, produced by the continual discharge of 100,000 cubic feet per minute from the Lough, during the 12 hours of cessation from work, may be conserved, and the power available in the working hours doubled in effect; that is, made equivalent to the work of 48 steam-engines of 102 horse-power each, for 12 hours per day.

During a large portion of the year, the discharge from Lough Neagh will be much greater than the above estimate, particularly during the season when the grain produced in the country is manufactured into meal and flour; in aid of which work, a large amount of the surplus power may be usefully employed, without abstracting in the slightest degree from the regular supply to the factories.

At Movanagher, the fall will be 8½ feet, equal to 1,606 horses. At Carnroe and the Salmon-leap, the effective falls will be 5 feet respectively, and equal to 945 horses each. The falls on the river being in succession, the proposed conserving process would have the same influence on all as it has at Portna.

The available power, therefore, on the whole of the Lower Bann River (according to the foregoing statement), would be equal to 120 steam-engines of 100 Bolton and Watt's estimated horse-power each, for 12 hours per day, independent of the surplus water which may be economised during winter, and likewise independent of any aid from Lough Neagh as a reservoir. Should, however, the demand for power become greater than the supply stated would accommodate, Lough

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	Superficial feet.
* The area of Lough Beg (see Map appended) is .	136,952,640
The superficial area of the River between Lough Beg and Kilrea, is	15,840,000
Gross contents, . .	152,792,640

Neagh may be made to furnish means so ample as to be far beyond the reach of useful exhaustion.*

The average rate paid at the Shaw's Water Works, near Greenock, for motive power, is £2 15*s.* per horse-power; but suppose it to be let on the Lower Bann at £1 15*s.* per horse, (the difference amply compensating for any supposed advantage from situation), it would, when fully occupied on these terms, produce a rental equal to £21,000 per annum. Say for work of 12,000 horses.

If attention be directed to the neighbouring districts of the Upper Bann and the River Lagan, it will be found, from the value there set on mill-power, and the care taken to economise its use, in situations greatly inferior to those on the Lower Bann, that there is little speculation in the anticipation, that the day is not remote when the whole of the power enumerated will be let at a sum fully equal to that above stated; particularly when we know that steam-power, at the very lowest estimated rate, costs twelve times as much as water power is here valued at.

Statements, such as we now make, cannot fail to excite surprise, when it is seen that water-power of such extent and value has been permitted to run to waste up to the present moment, without producing a single shilling of profit to man, or in any way assisting the productive industry of the country.

It is worth noticing, that within the last few years, a good deal of employment has been afforded by the manufacturers of the City of Carlisle, who send over large quantities of cotton warps to be woven by the hand-loom weavers of this district. Even in this limited way, the employment afforded is very beneficial to many poor families. But the circumstance cannot be passed by without exciting a desire to ascertain how the Carlisle merchant can import the raw material into an inland town, there forward the process of manufacture a stage by steam power, so as to make it ready for the loom; then send it from Carlisle to the North of Ireland to be woven, where an expensive establishment for superintendence is necessarily kept up, and finally, transport the goods produced to their destined market, and after incurring all these expenses, *still secure remuneration.*

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* 12 inches on the Lough would contain nearly 4,400 millions cubic feet of water.

† Mr. J. Scott Russell, in describing the prospective effects of the Shaw's Water Works, in his letter to the distinguished author of the Industrial Resources of Ireland, states that the water-power is equal to 30 steam-engines of 50 horse-power each; the realized supply being 2,500 cubic feet of water per minute, having a fall of 500 feet. In the present case, the Summer discharge through the Lower Bann is 100,000 cubic feet of water per minute, and the effective fall 31½ feet.

Assuming this to be so, we may fairly conclude, that were the raw material imported direct into this district, and the manufacture completed, as it might be by *water-power*, at one-fourth the cost of *steam-power*,* then shipped at once to its place of sale, for which great facilities will be afforded by the navigation of the Lower Bann, the amount of profit to the manufacturer, and the advantages to the country and to its labouring population generally, would be almost incalculably enhanced.

The estimated cost of the Works in the combined measure, including Interest on Capital, is £195,714 4*s*. 7*d*. (*See Abstract, page* 69.)

This sum may be divided as follows, the cost of mill power being added rateably *to drainage and navigation*:—

Drainage and Mill-power, . .	£109,314	4	7
To Navigation and Mill-power, . .	74,275	0	0
To Bridges chargeable to the Counties in which they are situate, . .	12,125	0	0
	£195,714	4	7

	£	s.	d.
* The Lough Island Reavy Reservoirs deliver their Water at per Horse-power, ...	3	0	0
The Shaw's Water Works, do.	2	15	0
Lough Neagh, by the proposed measure, do.	1	15	0
The same power had from Steam, either in Scotland or here, per Horse-power, from £20 to £30.			

To facilitate calculation, without materially affecting its general accuracy, I bring the amounts of the respective estimates to round numbers, thus:—

Drainage, ...	£109,500
Navigation, ...	74,000

And, as the bridges yield no profit, and the cost attendant upon their construction, is in all cases paid by the counties, I do not include them in the following account of profit and loss.

The water-power attainable being the result of the works required for drainage and navigation combined, I have not, nor indeed could I with accuracy make out, any estimate of its separate cost. I, therefore, divide the profits of this branch of the productive resources rateably between the other two measures, that is, in proportion to the amount of their respective estimates.

The flooded lands, per approximate survey, (*See Appendix, No.* 11,) amount to 25,000 statute acres. Taking the average value of improvement by drainage, as equal to 6*s*. per acre, it gives an annual revenue of £7,500, equal, say, to 7 per cent., profit on an outlay of £109,500, the sum charged to drainage.

The navigation, on which tolls may be levied, is 32 statute miles in length. Assuming that there will be only 65 tons of goods exported daily, and 35 tons imported, the result will be 100 tons carried 32 miles per day, say for 300 days, equal to 30,000* tons per annum; which, with a toll charge of 1*d*. per ton, per mile, will produce a gross revenue of £4,000 per annum. Deducting from this sum the cost of establishment and maintenance, at £1,520 a year, it leaves a net profit of £2,480, equal to 3⅜ per cent., on an outlay of £74,000, the sum charged to navigation.

Although water-power, which is here the result of the works both of drainage and navigation, will, *when fully economised,* produce a revenue of at least £21,000 a year, (see page 76) it is (to avoid any appearance of

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	Tons.
* Tonnage of Lagan Canal, in 1844, equalled . .	46,895
And of the Newry Canal, ...	43,515

exaggeration,) here taken at but $\frac{1}{5}$ of that amount, or £4,200. By adding this sum to the proceeds of th other works, in the ratio of their estimates, £2,800 a-year will be added to drainage, which increases its per centage from 7 to $9\frac{1}{2}$ nearly, and navigation, to which is added £1,400, will have its per centage value increased from $3\frac{3}{8}$ to say $5\frac{1}{4}$.

The net income, as stated, arising from the land drained, the navigation, and the mill-power, is in the aggregate, £14,180 a year, equal to $7\frac{3}{4}$ per cent., on the gross outlay of £183,500. Thus, in little more than 12 years from the completion of the undertaking, the project will work out its own redemption, even at the reduced value herein assigned to the profits on navigation and mill-power.

I beg leave, in conclusion, to express to the Commissioners, the very favorable opinion I entertain of the zeal and professional abilities of the Engineers appointed to assist me in this arduous inquiry.

Mr. WILLIAM FORSYTH, Mr. J. W. KELLY, and Mr. WILLIAM FRASER, both in the field and in the office, performed the several duties assigned to them with accuracy and considerable skill.

JOHN MAC MAHON, *C.E.*

Drainage Department,
Office of Public Works.

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DRAINAGE

Under the Act 5th & 6th Vic Cap.

LOUGH NEAGH DISTRICT.

LONGITUDINAL SECTION OF THE

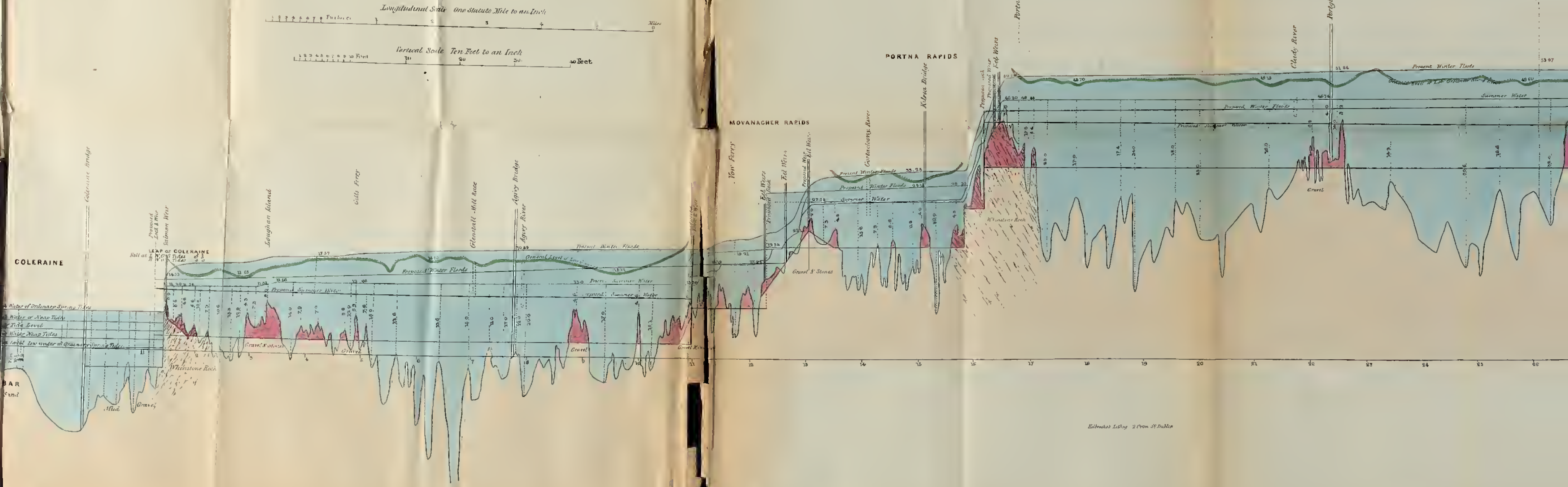
LOWER BANN RIVER,

FROM

COLERAINE to LOUGH NEAGH.

1844.

John MacMahon C.E.



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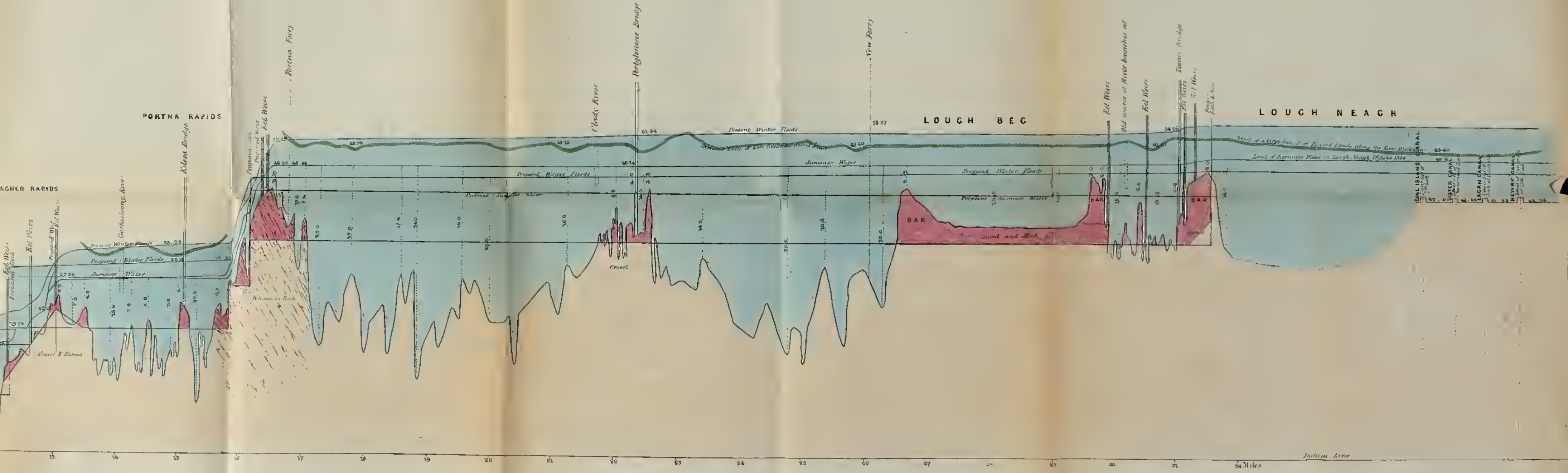

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APPENDIX.

APPENDIX, No. 1.

Detailed Estimate of the cost of the whole of the proposed Works.

	£	s.	d.	£	s.	d.
From Lough Neagh to New Ferry.						
Excavation in straightening the banks and enlarging the river channel above the level of low summer water, ...	12,500	0	0			
Ditto, excavation and dredging below the level of low summer water, ...	25,000	0	0			
Regulating weir at Toome Bar, .	4,800	0	0			
Canal lock at ditto, for the navigation, ...	3,500	0	0			
Underpinning Toome bridge, from the level of 33 feet above datum, and adding a navigation arch at the east or Toome end, . .	4,500	0	0			
Also rough moles or breakwaters for defending navigation and discharge at Toome Bar, . .	1,500	0	0			
Eel Weirs, . . .	1,000	0	0			
				52,800	0	0
Shoal at Portglenone.						
Excavation and dredging, .	4,732	10	0			
Bascule arch for the navigation, .	800	0	0			
				5,532	10	0
New Bridge at Portglenone.						
Chargeable to the counties of Derry and Antrim, . . .	7,200	0	0			
Carried forward,				£58,332	10	0

Brought forward,				£58,332	10	0
Portna Shoal.						
Excavation in deepening the river channel and sailing course, and in weir basin,	£17,396	15	0			
Regulating weir,	2,400	0	0			
Double lock for navigation,	7,000	0	0			
Eel weirs,	300	0	0			
				27,096	15	0
Kilrea Shoal.						
Excavation in shoal and side cut,	855	7	6			
Underpinning Kilrea bridge, and adding a bascule arch for the navigation,	2,000	0	0			
				2,855	7	6
Culmore Shoal.						
Excavation and dredging,				135	15	0
Movanagher and Carnroe Shoals.						
Excavation in river channel and side, or navigation cuts,	10,614	15	9			
Regulating weirs, and	3,000	0	0			
Locks for the navigation at £3,500 each,	7,000	0	0			
				20,614	15	9
Rooghan Shoal.						
Excavation in river channel,				937	10	0
Agivey Bridge.						
Constructing a timber bascule arch, &c.				500	0	0
Loughan Island and Cuts.						
Excavation in river channel,	4,875	0	0			
Do. in weir, basin, cuts, and lock-pit, &c., rock,	2,100	0	0			
Regulating weir,	2,000	0	0			
Lock for navigation,	4,000	0	0			
New cuts, including gangway,	1,000	0	0			
New house for fishery agent,	300	0	0			
				14,275	0	0
Upper Bann River.						
Excavation in shoals at Bann foot, Portadown, and upwards to Knockbridge,				6,000	0	0
If the cut from Slantry to Derryadd bay, or that this Lough Gullion be made, £5,000 additional will be required.						
Carried forward,				£130,747	13	3

Brought forward,				£130,747	13	3
River Blackwater.						
16,000 lineal yards of embankment between Charlemont and Verner's bridge,	£2,400	0	0			
Excavation in shoals and sharps, including bar at Blackwater and Maghery canal,	9,600	0	0			
1,400 lineal yards of embankment on the river Tall, from the Callan to Tall bridge, and on the Callan from the Blackwater to Callan bridge,	1,810	0	0			
Securing foundations of Verner's bridge,	190	0	0			
				14,000	0	0
River Torrent.						
Improving river channel,				500	0	0
River Moyola.						
Excavation and underpinning new bridge,				1,000	0	0
River Maine and Six-mile Water.						
Excavation of navigation channel at Main Waterfoot and at Six-mile Waterfoot,				1,330	0	0
Underpinning and extending existing wharfs on Lough Neagh, in consequence of retaining the water at a low level,				1,000	0	0
Scouring drains,				1,000	0	0
Lowering the lock sills on the existing navigations,				2,000	0	0
Improvements at Portmore Lough.						
Making new drain, and scouring and enlarging Tunny drain and Selshan drain,				1,708	0	0
				153,285	13	3
Ten per cent.,				15,328	11	4
				£168,614	4	7
Portglenone bridge,	7,200	0	0			
Charlemont and Blackwater bridge,	3,000	0	0			
	10,200	0	0			
Ten per cent.,	1,020	0	0			
				11,220	0	0
				£179,834	4	7

ABSTRACT.

	£	s.	d.
Toome,	52,800	0	0
Portglenone,	5,532	10	0
Portglenone Bridge,	7,200	0	0
Portna,	27,096	15	0
Kilrea Bridge and Shoal,	2,855	7	6
Culmore,	135	15	0
Movanagher,	20,614	15	9
Rooghan,	937	10	0
Agivey Bridge,	500	0	0
Loughans and Cutts,	14,275	0	0
Tributaries.			
Blackwater, Callan, and Tall,	14,000	0	0
New Bridge at Charlemont, and underpinning Blackwater Bridge,	3,000	0	0
Upper Bann,	6,000	0	0
Torrent,	500	0	0
Moyola,	1,000	0	0
Main Waterfoot and Six-mile Waterfoot,	1,330	0	0
Wharfs on Shore of Lough,	1,000	0	0
Scouring Drains,	1,000	0	0
Lowering Lock Sills,	2,000	0	0
Portmore Lough,	1,708	0	0
	£163,485	13	3
Ten per cent.,	16,348	11	4
	£179,834	4	7
Interest on borrowed money,	13,680	0	0
	£193,514	4	7

APPENDIX, No. 2.

Comparative Estimates of Works on the Lower Bann.

DRAINAGE ALONE.

Works at Toome,	£38,623	0	0
Portglenone, including new bridge,	11,932	0	0
Portna, including cost of lateral cut for mill power,	21,574	0	0
Kilrea,	1,777	0	0
Movanagher and Carnroe, including lateral cuts for mill power,	14,243	0	0
Rooghans,	418	0	0
Loughans and Salmon Leap,	10,275	0	0
	£98,842	0	0

	£	s.	d.	£	s.	d.
Carried forward,	98,842	0	0			
Less Portglenone Bridge, chargeable to county,	7,200	0	0			
	91,642	0	0			
Incidents, ten per cent.,	9,164	4	0			
	100,806	4	0			
Interest on borrowed money,	7,250	0	0			
	£108,056	4	0			
				108,056	4	0

NAVIGATION ALONE.

	£	s.	d.
Estimated cost of navigation alone, if carried out from Lough Neagh to Coleraine, after the drainage measure and concentration of water-power is effected, including incidents at ten per cent., and interest on borrowed money,	46,005	6	0
	£154,061	10	0

COMBINED MEASURE.

	£	s.	d.
Estimated cost of drainage, navigation, and mill power, carried out as a *combined measure*, from the Lough to Coleraine, including incidents and interest on borrowed money,	147,828	0	0
The money saving by combination is equal,	£6,233	10	0

Besides it saves the losses which would arise from stopping the supplies of motive power, and in a great measure the drainage of the country, whilst the navigation works are being carried on.

Appendix, No. 3.

Estimate of Cost of Drainage of whole District, with a measure of Navigation combined, from Lough Neagh to Kilrea.

	£	s.	d.	£	s.	d.
Cost of the drainage of the whole district,				£108,056	4	0
Estimate for works peculiar to navigation from the Lough to Portna, above the rapids:—						
One lock at Toome,	£3,500	0	0			
Regulating weir,	1,200	0	0			
Head and tail walls,	1,500	0	0			
Carried forward,	£6,200	0	0			

Brought forward,	£6,200	0	0				£108,056	4	0
Cost of channel from the Lough to New Ferry,	8,000	0	0						
Deepening Lough Beg,	5,500	0	0						
Portglen-one, {Ex. £1,000, BB. £800,}	1,800	0	0						
Wharf and sheds at each side of river at Portna,	1,500	0	0						
Road approaches to ditto,	500	0	0						
Part underpinning Toome bridge, . .	1,100	0	0						
	£24,600	0	0						
Ten per cent.,	2,460	0	0						
				27,060	0	0			
Lateral conduit for canal and mill supply to foot of rapids, including 10 per cent., ...				11,000	0	0			
							38,060	0	0
Cost of a partial navigation and the whole of the drainage, ...							£146,116	4	0

Appendix, No. 4.

The following is a copy of a Statement sent to the Provincial Bank in London, of the amount of the undermentioned Produce sold in Coleraine and the adjacent markets, for one year ending November, 1844. The Imports may be calculated at about the same amount.

£40,000,—In purchase of wheat, oats, barley, and potatoes, for consumption at home and exportation.
£40,000,—In purchase of provisions, principally slaughtered pigs.
£10,000,—In purchase of butter.
£100,000,—In the purchase and manufacture of linen, viz. about 80,000 pieces of 26 yards, valued at 25*s*. per piece.
£40,000,—In the purchase of flax.

And a great variety of goods not mentioned.

Appendix, No. 5.

Tolls payable on the Lagan Navigation, not to exceed one penny per ton per mile.

Belfast towards Lisburn, 1*d*. per ton per mile.

	s.	*d.*	
Lisburn, ...	0	8½	per ton
Head level, ...	0	0	,,
Any level west of the summit or Lough Neagh,	1	6	,,
Lough Neagh to Belfast, . .	1	0	,,
,, ,, Summit, . .	0	6	,,
,, ,, Lisburn, . . .	0	9	,,
Lisburn to Summit, ...	0	3½	,,
Summit to Lisburn, . . .	0	3	,,
,, Belfast, ...	0	6	,,

Timber in rafts charged 1*d*. per ton additional—a man in the employment having charge of each raft as far as the Summit.

Any part of the Summit to any other part 1*d*. per ton per mile not to exceed 6*d*. per ton.

2*d*. per ton for loading or discharging on the west level, that next to the lake.

Appendix, No. 6.

Table of the Traffic on the Newry Canal, between Newry and Lough Neagh, from the year 1837 to 1844, both years inclusive; distinguishing the Exports from the Imports, thus—

Articles imported into Newry by Inland Canal, consisting of grain, butter, flax, whiskey, &c. &c., from Enniskillen, Monaghan, Ballyronan, Moy, Portadown, &c. &c.		Articles exported from Newry by Inland Canal, consisting of coals, timber, flax-seed, iron, tallow, &c. &c. to Enniskillen, Monaghan, Ballyronan, Moy, Portadown, &c. &c.	
Year.	Quantity in Tons.	Year.	Quantity in Tons.
1837, . .	12,025	1837, . .	17,469
1838, . .	12,609	1838, . .	17,609
1839, . .	11,597	1839, . .	19,339
1840, . .	13,349	1840, . .	21,655
1841, . .	15,801	1841, . .	20,818
1842, . .	15,606	1842, . .	25,646
1843, . .	16,618	1843, . .	19,227
1844, . .	17,785	1844, . .	25,730
Total, .	115,390	Total, .	167,493

APPENDIX, No. 7.

Traffic of the Tyrone or Coal Island Navigation.

IMPORTS FROM BELFAST AND NEWRY—QUANTITY IN TONS.

Articles.	1837.	1838.	1839.	1840.	1841.	1842.	1843.	1844.
Merchant Goods, .	2050	1700	2200	1850	2000	2110	1775	2167
Coals, . . .	250	50	50	50	50	250	350	495
Salt, . . .	100	100	50	150	–	225	350	550
Slates, . . .	150	200	250	100	150	325	178	500
Flour, . . .	50	50	–	–	–	25	25	–
Foreign Timber, .	300	450	150	150	250	250	910	533
Native Timber, .	–	–	300	100	–	86	–	250
Wheat, . . .	–	–	250	650	350	540	440	290
Meal, . . .	–	–	50	50	–	–	25	–
Barley, . . .	–	–	–	–	50	75	–	–
Mixed cargoes, consisting of Planks, Iron, Tallow, Flax Seed, Herrings, Resin, &c.	–	–	–	–	–	–	–	–
Total Imports in each year	2900	2550	3300	3100	2850	3886	4053	4785

EXPORTS TO MOY, BELFAST, NEWRY, PORTADOWN, LURGAN, AND BLACKWATERTOWN.

Articles.	1837.	1838.	1839.	1840.	1841.	1842.	1843.	1844.
Wheat, . . .	350	600	350	200	50	275	475	425
Oats, . . .	3000	4245	2400	2050	2350	1500	1700	2150
Coal, . . .	800	1050	2205	3742	1575	1350	950	1325
Bricks and Tiles, .	750	875	1300	1640	1350	2275	1750	2985
Pottery Clay, . .	200	445	150	342	300	175	50	400
Potatoes, . . .	50	–	–	–	50	150	50	–
Flour, . . .	–	100	–	175	165	375	150	90
Meal, . . .	–	300	–	75	150	100	125	90
Sand, . . .	–	–	50	100	–	75	–	100
Flax, . . .	–	–	–	–	50	–	150	723
Home Timber, . .	–	–	–	–	50	50	–	110
Stones, . . .	150	150	325	115	950	–	400	85
Total Exports in each year	5300	7765	6780	8439	7140	6325	5800	8483

APPENDIX, No. 8.

SANITARY RETURNS.

THE Commissioners of Drainage deeming it of importance to collect evidence as to the effects which the exhalations arising from marshes, formed on the annual retiring of the pent up waters, had on the health of the population in their vicinity, addressed the following Circular to Medical Gentlemen in charge of Dispensaries, on the subject of the Sanitary condition of the inhabitants of their immediate districts.

Office of Public Works.

SIR,—A very interesting Tabular Statement has been presented to the Commissioners of Drainage, with reference to the project for preventing the periodical floodings of lands bordering on Lough Neagh and its tributaries, prepared by a Medical Gentleman who had charge of Dispensaries in three localities, one in the midst of lands subject to inundation, another four miles distant from those lands, and the other in a hilly country.

The Table gives the proportion in each year, at those several places, of fever and rheumatism, two diseases considered to be greatly influenced by the moisture produced by the evaporation and the exhalation of wet soils.

The result shows a considerable increase in the proportion of cases in the first locality, and most especially in the cases of fever, during the last year, 1844, which broke out immediately on the disappearing of the water from the low flooded lands, which took place in that season much earlier than usual, the fever being of the spotted kind, such as is apt to arise from marsh miasma.

It would be a matter of considerable interest, if similar comparative statements could be obtained in other parts, of the Sanitary condition of such districts as are supposed to be influenced by causes which may be removed by the Drainage measures about to be undertaken in Ireland, and where the observations of a few years succeeding any such Drainage may prove how far the effects have been really produced by those causes, and how far these mechanical operations may have a beneficial influence on the health of the inhabitants.

The Commissioners seek your co-operation in the acquirement of similar information from the locality in which you practise.

For this purpose, I am directed to enclose you a printed form which you will please fill up, if you have the necessary means, and return to this office at your earliest convenience, accompanied by any observations bearing on this interesting subject of inquiry, that you may deem it useful to offer.

I have the honor to be, Sir, your most obedient Servant,

(*Signed*) HENRY R. PAINE, *Secretary.*

The gentlemen thus applied to, were prompt in their several answers; but I regret to say that few were enabled to supply the detailed information the Board sought to obtain, from want of proper records being kept in the offices of the several Dispensaries.

Their individual opinions coincided in almost every instance with their more practised (because more systematized) English brethren, namely, "that Drainage of land increases the healthiness of the Country." And it is to be earnestly hoped, that if a similar inquiry to this be hereafter-instituted, those public officers will be enabled by the Grand Jury regulations of their respective counties, to state from authentic records the circumstances in the external condition of the poorer classes, which most promote the spread of fever, and of febrile diseases.

Out of the many returns which have been obtained from several parts of Ireland, those have been selected which bear more immediately upon the subject under consideration.

CO. ANTRIM, *Cushendun.*

DR. HOUGHTON remarks, that although this district is rather hilly, it abounds in springs which cause great dampness, and that the frequent occurrence of cess pools of stagnant water, &c. is highly injurious to the health of those residing near them.

TOOM.

DR. GODFREY states, that in December, 1844, there was very heavy rain, which was allowed to remain about the residences of the lower order of the inhabitants, the consequence of which was, that there was an unusual amount of Typhus Fever, no house in the neighbourhood having escaped

Co. CARLOW, *Fever Hospital.*

DR. CONNOR, in his report of this hospital for the year, 1844, which he has kindly sent, states. "The poor are badly supplied with water, whilst, from want of sewerage and drainage, much of a positively noxious quality is always present; witness the stagnant pool opposite the Court-house, (Town of Carlow,) and from the immediate vicinity of this pond, and such places as M'Gennis's water, &c., &c., have been admitted nearly all the 450 patients who were received from the town during one year."

Co. CLARE, *Farbane.*

DR. FRY has found that rheumatism is much more prevalent in the vicinity of rivers, whose banks are overflowed in the winter months.

Co. DERRY, *Moneymore.*

In this district, inflammation of the eyes is the most frequent disease, which DR. MAXWELL attributes to the nearness of Lough Neagh.

Co. DONEGAL, *Kilteevock.*

DR. CONNOR considers that fever in his district is caused by the exhalation of a wet and marshy soil.

Co. DUBLIN, *Rathcoole.*

DR. O'KELLY in furnishing his report, has divided his district into hills, uplands, and bottoms, with respect to which he states, that the hills being well drained, are very healthful, the uplands are remarkably healthy, and that the few living in the bottoms are much subjected to rheumatism.

Co. MEATH, *Clonard.*

DR. LIGHTBURNE is decidedly of opinion, that the exhalations from wet soils has much to do in the production of fever and rheumatism, especially Typhus fever.

Co. ROSCOMMON, *Croghan.*

DR. WALLACE gives a return for this district, which shows that fever has very much decreased within the last six years, and which decrease he attributes to the extensive drainage of the district, which has lately been effected. The number of fever cases in the year, 1832, was 135; that in 1839, 55; that in 1843, 1; and in 1844, 7; showing in six years a decrease of 48 in the number of cases, and of 128, in twelve years.

Co. TYRONE, *Omagh Fever Hospital.*

DR. HAMILTON states, that in the years 1843 and 1844, the fever was of the spotted kind, such as would be caused by marsh miasma.

Co. WEXFORD, *Arthurstown Fever Hospital.*

DR. LONG, in his last annual report, states, that "to the west and north west of this tract of land, there is a large quantity of alluvial deposit, to the extent of many acres, which at each recession of the tide is laid bare, and such as was favourable for the production of noxious miasma. The winds also on this coast are from S.S.W. to W.N.W., and that the mortality in that particular district was very great."

Co. ARMAGH.

DR. ARDAGH, of Verner's Bridge, states: "I have been medical attendant to this Dispensary for nearly nine years; part of my district runs along the Blackwater River, for about four miles, which overflows to a considerable extent every year. I have observed, that families residing near these low lands, which are subject to flooding, are every year attacked with three different diseases—fever, rheumatism, and inflammation of the lungs. I can safely say, that the former of these diseases commences every year in the locality above alluded to, and of course spreads to the neighbouring townlands.

The following extremely interesting document, supplied by DR. BREDON, of Portadown, demands particular attention:—

"Having had many opportunities, after an experience of eleven years' practice in this neighbourhood, of estimating the effects caused by the extensive surface of water covering a large tract of country around Portadown, during a great part of the year; the moisture produced by evaporation, and the exhalation arising on its disappearing off the marshes in the summer, on the health of its inhabitants, and their influence, as an origin to some diseases so prevalent in that district.

"To substantiate which, I give the following comparative list, as taken from my Dispensary Reports, of the two diseases so mainly attributable to these causes, namely, fever and rheumatism:—

Year.	*Diseases.*	PORTADOWN.	TANDRAGEE.	TULLYHAPPY.
1834,	Fever,	1 in 37	1 in 55	1 in 36
„	Rheumatism,	1 „ 35	1 „ 77	1 „ 30
1835,	Fever,	1 „ 63	1 „ 111	1 „ 76
„	Rheumatism,	1 „ 48	1 „ 54	1 „ 75
1836,	Fever,	1 „ 22	1 „ 28	1 „ 42
„	Rheumatism,	1 „ 69	1 „ 57	1 „ 46
1837,	Fever,	1 „ 11	1 „ 21	
„	Rheumatism,	1 „ 59	1 „ 54	
1838,	Fever,	1 „ 19	1 „ 23	
„	Rheumatism,	1 „ 63	1 „ 65	
1839,	Fever,	1 „ 15	1 „ 27	
„	Rheumatism,	1 „ 29	1 „ 33	
1840,	Fever,	1 „ 9	1 „ 32	
„	Rheumatism,	1 „ 45	1 „ 54	
1841,	Fever,	1 „ 31	1 „ 49	
„	Rheumatism,	1 „ 51	1 „ 39	
1842,	Fever,	1 „ 35	1 „ 99	
„	Rheumatism,	1 „ 42	1 „ 65	
1843,	Fever,	1 „ 38	1 „ 88	
„	Rheumatism,	1 „ 62	1 „ 68	
1844,	Fever,	1 „ 7	1 „ 89	
„	Rheumatism,	1 „ 58	1 „ 45	

"During the years 1834–35 and 36, I had dispensary attendance in three different localities, viz., Portadown, Tandragee, four miles distant, and Tullyhappy, twelve miles from the former, and situated in the hilly country, north-west of Newry. During the last eight years I attended only at the former places; and from the different reports, I have given the above table, showing the proportion out of the patients registered in each year.

"The preceding list shows the extreme prevalence of these diseases about Portadown, and a majority above both the other places, even with a very great advantage above either in a supply of fuel. But a most remarkable fact connected with the subject is, the break out and prevalence of fever in this neighbourhood, during the past year. Immediately on the disappearing of the water off the marshes, which took place much earlier this season than usual, fever commenced at a time when the weather was hot and dry, in the townland of Ballywarken, which lies flat, and is in a great degree surrounded by water in winter. The first day of my visit, on the occasion, I was called into twelve houses; the progress was rapid, and extended into four or five townlands, till at the year's end eight hundred and fifty-two cases were registered, nearly all of which were of the spotted kind, such as is apt to arise from marsh miasma."

Appendix, No. 9.

ECONOMIC GEOLOGY.

A brief description of the Geological products of the shores of Lough Neagh, and of the adjoining Districts, which are more immediately of economical or industrial value, by Professor Oldham,—August, 1845.

The Lower Bann River, throughout the entire of its course, follows the natural depression in the trap rock, which forms the prevailing surface rock in the County of Antrim, and the eastern portion of Londonderry, and similar rock forms the entire *eastern shore* of Lough Neagh itself, and a large portion of the western, extending southward to Arboe.

The southern and south-western portions are composed of a very thick deposit of tertiary clay, adapted to pottery uses, while along the shores of the Lough, in several places, deep and valuable peat bogs abound.

As already stated, a large portion of the shores along the southern and south-western parts of the lake, consists of beds of clay, in some cases covered with peat bog, extending continuously from the entrance of the Lagan Navigation, at the south-east corner of the lake, to the neighbourhood of Portadown, and by Charlemont to Coal Island, and northward to Arboe point, on the lake, occupying a space of nearly 75 square miles. It is, in most cases, of a white or brownish white colour, but has also alternating beds of a greenish tint, and layers of white or gray sand. In it are also irregular seams or large lenticular masses of lignite, or wood coal, which in some places, (as at Sandy Bay, at Antrim,) is so abundant, that during wet seasons, which have prevented the saving of the turf harvest, it is used as fire for domestic purposes. But to form a just idea of the true extent of this deposit, we must consider not only its superficial extent, but its thickness; and when it is known, that in more cases than one, borings have been made through it, to the depth of upwards of 250 feet, without reaching the subjacent rock, it may fairly be said, that the supply is almost inexhaustible. The deposit seems to be of lacustrine origin, and would therefore tend to prove that the waters of the lake, at the time of its formation, stood at a level much higher than they do at present.

In many places, the clay referred to, is used for the manufacture of coarse pottery ware, tiles, and bricks; it loses its colour and becomes brown when baked, and is therefore not very applicable to finer work; but for common purposes, and for the manufacture of tiles, &c., it cannot be excelled, when properly prepared and tempered; hitherto, however, the difficulty of communication, and the necessity for long and consequently expensive land carriage has limited most materially the range of country which the manufacturers could command as markets. And as a curious result of this, combined with other causes, it may be mentioned, that in many cases the English manufacturers of coarse pottery could send into the market of Dungannon, the same, or even a better class of articles, at a lower rate than they could be supplied by the local makers. It must be admitted, there is always a great difficulty in commanding a sale where new and comparatively little tested articles are contending against goods of a well-known and established character; but, independently of this, the limited demand, and therefore intermitted nature of the manufacture necessarily compels it to be carried on at greater disadvantages, not only as regards expense, but also the quantity of the goods made, than it would be when the workmen, by constant employment and sub-division of labour, acquire that manipulative skill, which long experience alone can teach, and which enables them to produce a larger amount of work, and of a higher standard of excellence, in a given time.

It cannot be doubted but that at the present time the manufactury of tiles, bricks, &c., for which the clay is admirably adapted, might be carried on with profit to a very much greater extent than it is, in a locality so favourably situated. And it is obvious, that the opening up of a communication by water with Coleraine, and all the intervening districts will tend much to extend the demand for such articles.

Nor will the importance of this manufacture, as a source of employment and wealth, appear over-rated, if it is borne in mind that in 1840, when the use of tiles was but little known, and with all the disadvantages arising from the winter floods, which make it almost impossible to keep the pits free from water, there were yet manufactured in the barony of Dungannon alone, (not one half of the entire district,) upwards of 1,135,000 bricks, and 128,000 tiles, and coarse pottery ware, to the value of nearly £3,000, this pottery being the produce of about a dozen kilns of the rudest construction and worked only at intervals.

In the County of Derry also, near Castledawson, clay of a similar character abounds, and is manufactured by machinery got up with little mechanical skill, and without any of the regular appliances of such a trade, into articles of coarse pottery ware which find a market in the adjoining towns. The manufacture affords employment to a considerable number of persons, but conducted in the least skilful way, and only at intervals, and generally in connexion with farming occupation, thus distracting the attention of those engaged, and preventing either pursuit from being attended to with proper zeal, it is perhaps in this way of more real injury than service to the district.

In connexion with these clays, although geologically belonging to the coal series, we should notice the manufacture of fire bricks at Coal Island. The material of which they are made is the fire clay or Stourbridge clay, which forms the seat or bed under the coal in this district, and is raised from pits sunk for the purpose.

These bricks are manufactured with care, and are of excellent quality, fully equal to the well known Stourbridge bricks; they are made of all sizes, and moulded for arches, circular work, &c. &c., and they now find a tolerable ready sale, being stamped with the words "STOURBRIDGE WORKS," passing in the market as of English manufacture.

In 1840, 403,000 of these bricks were made at Coal Island, and the manufacture has, I believe, since increased. They are sent to Belfast, Dublin, and even to the south of Ireland.

The limited demand which must necessarily exist in any one locality for articles of such occasional use as these fire bricks, renders the facility and economy of communication, of peculiar importance as regards their manufacture.

The quantity of this clay in the district of Coal Island is very great. Most of the beds of coal rest on beds of clay, varying from 4 to 6 feet in thickness; but from many causes, among which we may suppose that the want of industrial energy, and the uncertainty of demand, are not the least, it is not raised at all.

Dr. Kane has given an analysis of the clay, from which its composition appears nearly identical with that of Stourbridge, a portion of the alumina in the latter being replaced by peroxide of iron in the Coal Island clay. Its ingredients are:—

Silica,	46.2
Alumina,	30.8
Peroxide of Iron,	8.4
Potash,	0.4
Water,	14.2

and it is to the presence of the peroxide of iron, that the brown colour of the burnt clay is due. But there is perhaps no Geological product, which is of greater interest, economically, than fuel, and of the three principal forms in which this has been given to man, viz., coal, peat, and wood, the two former occur in this neighbourhood, in considerable abundance. Of these, coal unquestionably stands highest, whether we consider its value in the production of the comforts and luxuries, or of the necessaries of life, or as the great agent which has enabled the human mind to call into effective being its grandest conceptions, and the use of which has given a stimulus to the onward progress of civilization, alike unforeseen and unequalled.

The Tyrone coal field stretches from near Dungannon to the north of Coal Island, and for its extent is richer than any other in Ireland, containing no less than nine workable beds of coal, and in one pit no less than 20 feet of good coal have been met with in a sinking of 300 feet from the surface. The coal is of ordinary flaming quality, burns rather swiftly, and with a strong heat, and that from most of the beds leaves a considerable quantity of ashes.

But notwithstanding the peculiarly favourable circumstances under which such an amount of useful coal is met with, as regards its depth from the surface, and the absence of much water, and its freedom from dangerous gases, the coal in this field is extracted only at considerable expense, owing to the many dislocations and faults which disturb the strata, and render the amount of work to be won from any pit uncertain, and also to the very soft and yielding nature of the seat of the coal, (the fire clay to which we have already alluded,) and into which the timber props used to support the roof, rapidly sink; indeed the amount paid for timber for props is one of the heaviest items in the cost of working these collieries.

Somewhat more than one-half of the coal extracted is, after screening small coal, used exclusively in the manufacture of bricks, and the burning of lime, the other, or large coal, being used chiefly for domestic purposes, and for breweries, distilleries, &c. &c. The fact that much of the coal is drawn from the pit mouth to a distance of from 15 to 20 miles, is sufficient to point out the advantage which must be the result of any improvement in the means of communication, and the consequent extension of the markets; more especially, if this communication be by water. At the present time about one-sixth of the produce at Coal Island is shipped on board lighters, and transmitted by the Coal Island canal to Blackwatertown and other places on the borders of the lake; and it cannot be doubted, but that the establishment of depôts or yards, where a regular supply of this coal could be kept, in such towns, would place its use within the reach of hundreds, who are now debarred by the expense of transport, and are thus rendered dependent on the precarious supply of peat fuel. If we suppose that the use of this coal extends over a circle of 15 miles radius from the pit mouth, each additional mile adding most materially to the cost of carriage by land, and if we also consider how very trifling an addition to the price of coal at the pit would repay the expense of transport to a great distance by water, if regular and uninterrupted communication be established, it must be obvious, that the demand will be extended to the districts included by a circle of nearly equal radius round each of those towns in which such depots should be established; and thus hundreds and thousands, at the distance of many miles, will be supplied with that fuel so necessary for their comfort, at a price slightly exceeding that at which it could be procured in the more immediate vicinity of the pits, while the increased demand would give rise to increased exertions to produce the supply.

Nor should it be objected, that from the smallness of the field it would soon be worked out. It is not much more than a year, since pits have been opened and continuously worked, where seams of coal were not previously thought to exist; and it has been well remarked by Capt. Portlock, in his Geological Report, "that the fear of working out a colliery is no good reason for starving the supply. Bring the coal to the door of the consumer, who has yet to learn its use, and when he has done so, he will encourage its importation and transmission from other countries. Even should the home supply fail, let not the philosopher be afraid of creating a new appetite for coals, as, on a principle of common prudence, it is more desirable to possess that appetite now, when coals can be procured at a reasonable price, than at a future period, when the price will be necessarily much augmented." (*p.* 608.) And in this field especially, the greater the rapidity with which the coal can be extracted, the greater the economy attending the work; for, as we have already hinted, one of the great sources of expenditure is the difficulty of keeping open the headways and levels, so that even on pecuniary considerations alone, independently of higher objects, the more extended the market, and the more rapid the demand, the greater the profit attending the working.

But the supply of fuel for the districts adjoining the lough, is not confined to the coal; large tracts of excellent bog occur along the Blackwater and the shores of the lake, and even now afford employment to many, in the preparation of turf. Nor is this of local importance only, for it must be remembered, that the whole eastern shore of the Lough is almost entirely deficient of that fuel, and in some years the want is most severely and acutely felt in this populous, but not very wealthy district.

The proper preparation of this peat is at present much impeded by the annual winter floods of the lake and river, and consequently the proposed retention of its level, at the height of summer water, coupled with improved modes of drying and preparing the turf, will enable it to be made much more economically and extensively than at present, while it will also render it possible, to bring much of the surface of the bog into useful cultivation, a plan which has been adopted with considerable success, under the direction of Mr. Blacker, along the banks of the Coal Island Canal.

It would lead into too great detail to notice many other questions of economical interest connected with the Geology of this district; the occurrence of sulphate of lime, useful both as a source of Plaster of Paris and as a manure of Barytes, used extensively as a pigment, and which is so abundant in Derry and Tyrone, of sulphuret of iron, &c., &c., all of which are to be found in the vicinity of the lake; and we shall therefore do nothing more than merely mention them. The abundance of building materials, also the prevalence of lime in parts of the district, and its absence in others, where, from the nature of the soil it is almost essential as a fertilizer, are sufficiently obvious to every one.

We have before alluded to the proof which the occurrence of the clays of lacustrine origin, at the heights considerably above the present level of the waters of the lake, affords, that its waters once stood much higher than at present. But it should be remembered that this was at a period probably very long anterior to the existence of any historical records; while it appears to be placed almost beyond doubt, that at a more recent period its waters were at a lower level than at present. But at the same time, the existence of old charts would also seem to show that the depth of the waters of the lake has not sensibly decreased within the same period.

The great amount of detritus weed, &c., brought down by the numerous rivers which flow into the lake, is in a great measure deposited over its bed; and it is not improbable that the rising of its waters may (in part, at least,) be due to this silting up of its bottom, while the supply of water has not been diminished, and the power of discharge has been lessened.

The smaller lake of Lough Beg is unquestionably filling up, and that not very slowly; and should the waters be kept at their summer level, it is probable that the greater portion of its surface will be silted up to that height, and the waters subsequently confine themselves to a defined channel through it.

The question of water-power derivable from the Lough and rivers, concerns the Engineer and the Geologist; although, as we have before stated, the circumstances which gave rise to the existence of that power are essentially and obviously geological.

Whether, therefore, we consider the lake merely with reference to its size, as the largest in the British Islands, or as a great reservoir, beneficently ordained by Providence to curb the destructive ravages of its otherwise uncontrolled floods, as affording a motive power for industrial purposes, as constant as it is effective, or as a great highway of communication—from all these points of view, the examination of its features opens up questions of great practical importance; and while a review of its present improved state can only awaken feelings of regret at the neglect of so many advantages, we look forward with earnest anticipation of the benefit which must result from the skilful application of the resources of science, in the development of the economical relations of so favored a locality.

(Signed)

THOMAS OLDHAM,
Professor of Geology, Trinity College, Dublin,
M.R.I.A., F.G.S.L.

APPENDIX, No. 10.

CATCHMENT OR RAIN-BASINS of Lough Neagh and its Tributaries, also of its discharging River, the Lower Bann.

Area of Lough Neagh,	153½ Square Miles.
Upper Bann River Basin,	208
Blackwater River Basin, which includes the River Callan, Tall and Torrent, &c.	618½
Ballinderry River Basin,	161¼
Ballyronan Basin,	11
Moyola River Basin,	140½
Stewartstown Basin,	30¼
Portmore Lough and Closet River,	68¾
Crumlin and Glenavy River Basin,	67¾
Six-mile-water Basin,	92
Maine River Basin, which includes the Rivers Clough, Braid, and Kells, &c.	313¾
	1,865.
Lower Bann, and Lough Beg, which includes the Clady, the Inveroe, the Agivey, and the Macosquin,	340½
	2,205½ Square Miles

APPENDIX, No. 11.

FLOODED LANDS.

TABLE showing approximately, from a perambulatory Survey of the district, with the aid of the Ordnance Maps, the quantity of Land injured by the overflowing of the Waters of Lough Neagh, its tributary Rivers, and its discharging Channel, the Lower Bann, noting the extent appertaining to each River, or division of country respectively.

	Statute Acres.
River Blackwater and its Tributaries,	6,500
Upper Bann,	4,500
Shores of Lake from Blackwater Foot to Lagan Canal, including Closet River, and Derryad Bay,	2,000
At and about Lagan Canal, and thence to Lough Portmore,	3,500
From Lough Portmore, including Shores of Lake, River Crumlin, Six-mile Water, and Main Water, to Brokish Bay,	1,500
Toome, Creagh Bog, Shores of Lough Beg, and Moyola,	3,750
Shores of Lake, from Moyola River, round to the Blackwater Foot, including the Ballinderry River,	750
Lower Bann and its Tributaries,	2,500
Total extent of Flooded Lands in Lough Neagh District,	25,000

LOUGH NEAGH DRAINAGE.

REPORT ON THE VALUATION OF THE FLOODED AND INJURED LANDS.

Custom House,
Dublin, 24th December, 1845.

Sir,—Though I have completed the field work of the detailed Survey and Valuation of the flooded lands in Lough Neagh district, yet I will be unable to finish the Schedules thereof in sufficient time to accompany the Report of the Engineer; but I deem it necessary to inform the Commissioners, that the owners of those lands will derive considerable benefit by the works which are proposed for keeping the waters of Lough Neagh and its tributaries at or about the summer level.

Along the Upper Bann the surface soil of the lands is a deposit, from the flood waters, of the finest parts of the soil of the surrounding country, which supplies the waters, and varies in thickness from 12 to 20 inches, resting on bog. This soil, if freed from the waters, which lie so long on it as to perish all good grasses, would be very fertile and produce excellent crops. In its present state, it produces an inferior herbage, ill adapted for hay, both from its quality and the difficulty of saving it. It is very soft, and lies together so as to get matted. Indeed, many of the people are of opinion, that only for the large quantity of coarse reeds and weeds, which they call "Bann Sallows," that grow amongst it, and in saving prevent its being so much matted, it could not be made into hay. A large tract of land near Toome, called "The Creagh," is of similar quality with that along the Upper Bann.

The lands along the Blackwater, Callan, Tall, Mayola, and other streams, are of superior quality, both as to soil and herbage, to those first mentioned, and bring very high rents, as *con-acre meadow*, some of them so much as £4 to £7 per statute acre, while those first mentioned range from £2 to £4.

In some places the occupiers take grazing cattle on those lands; but perhaps in a month after the cattle are put on, a flood comes and covers the place, leaving inches of dirt after the floods have fallen. The cattle have to be removed; the owners of the land frequently get nothing for the previous grass; the people have not other grass, and in many cases of this kind are obliged to sell the cattle at considerable loss.

Along the Bann, Blackwater, and in other places, the people estimate that in a period of six years, their annual loss on an average amounts to two entire crops, or one-third of the produce; and in consequence several efforts have been made at different times to avert the evil, by embankments, some of which have proved total failures, and others that are yet maintained have produced only partial relief. Of the former class, I may mention the attempt that was made about the year 1740 to free the lands around Portmore Lough, and in later times, the efforts made by Lord Lurgan, near the Bann foot. Of the latter class may be mentioned, the embankments on parts of the Blackwater, Callan, Tall, and Cusher Rivers. The last, the most successful, has been carried on by the Duke of Manchester. The improvement effected by His Grace on some meadow and grass lands, lying along the Newry navigation, and between it and Tandragee, is well worth the inspection of any person having doubts as to the benefits to be derived by freeing lands from floods. The produce in grass of some of those lands is unusually great.

It might be supposed that where meadow land rates so high as I have already stated, that the owners would not devote such land to the purposes of cultivation; yet such is not the fact. Wherever embankments have been made, the people have almost invariably availed themselves of the *chance of protection*, by cultivating those holms along the rivers; and when the density of the population in this district is taken into account, the exhausted state that the uplands are, from continual cultivation, reduced to, and the amazing fertility of those *new* lands along the rivers, it is not to be wondered at that they should be anxious to cultivate them whenever there was a chance of securing the crop without injury; yet they often suffer heavily by doing so. The crops that are so luxuriant to-day, may, by one evening's rain, be totally destroyed—the very soil on which they grow, for some inches in depth, carried away—leaving the owners almost beggared next day. Such results happened very generally through this district in June, 1843.

When a flood is apprehended at night, these poor people are up until morning, mending, raising, and protecting the banks wherever necessary. They are in a continual state of inquietude. Indeed, one man, near the Bann Foot, told me his father died of a broken heart, in consequence of the losses he suffered, and the debts he was obliged to incur, owing to floods.

Under such circumstances it is not to be wondered at that they should be, as they are, so anxious and unanimous in their endeavours to get rid of those evils. I may mention one striking instance as to the amount of benefit they anticipate by having their lands freed from floods—namely, that a great part of the money which has been lodged with the Commissioners, for the purpose of making the necessary Surveys, Valuation, and Estimates connected with this inquiry, has been subscribed by the tenant occupiers of those lands.

In addition to those lands which I have described, and which, with all the loss and injury attending them, are still of considerable value, there is a large extent of land that in its present state is almost valueless, but is capable of being brought into profitable cultivation by the facilities that would be afforded in keeping Lough Neagh, and its tributary rivers, at or about summer level. I allude to the extensive tracts of *cut out bog*, called "Montiaghs," in the neighbourhood of Portmore Lough—"Montiaghs" along the Bannfoot, Ballyworkan bog, south of Portadown, and others of less extent. These Bogs, or "Mosses," as they are called, were heretofore very valuable as turbary, but, as such, are now useless, having been cut down in some places near to the gravel or clay on which they lie, or so low in other places that, in the present state of floods, no more turf can be had out of them. If the waters be kept down to the proposed level, these cut out bogs could be profitably cultivated, and might be almost looked upon as grants of new lands to the parties interested.

The people through the district generally, say; that if the floods be prevented, it will be the best thing that ever happened for Ireland, for they cannot believe that any other place suffers so grievously as their own, and they seem to appreciate fully their loss. They say that even the year in which they succeed in maintaining the embankments against the floods, that their loss is considerable in that very maintenance. The banks being injudiciously made along the *brink* of the river, are continually giving way from the undermining of the current, the repairs of which must be made from their grass lands or meadows, in order to have sods of sufficient adhesion for the purpose; then, in order that the holes from which the stuff for repairs is taken, may not be useless, they have to bring stuff from other parts of the farm to fill them up, so that the expense of maintaining these embankments is much greater than might be at first anticipated. Indeed, some of the people say they scarcely know what rent they would refuse for those holms, if freed from inquietude, and the expense of maintaining the embankments.

From my experience of the benefits derived in other cases of improvements of this nature, and so far as I can judge, without having made my calculations, I am of opinion that the improvement in the lands of this district, if the proposed works be carried out, will, on an average, be twenty per cent., on their present fair value.

In connexion with the certainty of getting the entire produce of those lands, without any loss or damage, and which seems to be the engrossing object of the occupiers, I wish to draw attention to the fact, that the flooding of lands under certain circumstances, is of vast benefit; that is, when the waters are under such control as that they can be let on and off the lands whenever the owners wish; this can be effected, when the proposed works are carried out, at little cost, by the erection of sluice-gates at suitable places; thus securing the entire benefit, without any of the loss, attendant on those floodings; and to those who estimate the benefits of flooding, it is well to call attention to the fact, that the advantages will not be got rid of with the disadvantages, but that the former will be secured, and the latter avoided. These advantages can be had to the *fullest* extent on all the streams and rivers in the district, except the Bann, which, in consequence of its navigation, will not partake so largely of the benefits of flooding. But the numerous small streams and springs that pass from the higher lands into it at different points along its course, affording great facilities for irrigation, which will no doubt be made available for the purpose, will in a great degree supply benefits similar to those which can be had on the other rivers.

Of the evils arising from those long-continued floods, in a sanatory point of view, I am unable to offer any opinion, but that they are many and great is generally admitted and believed. The persons in and about the district will, no doubt, from their local experience, be able to form a just notion. A respectable medical gentleman, residing in Portadown, told me, that he knew places along the Bann where fever and other disease, arising from the humidity of the place, is to be met with from year to year, and almost throughout the entire year.

I am, Sir,

Your obedient Servant,

R. HARDING.

To

Henry R. Paine, Esq.,

&c., &c., &c.

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